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ABSTRACT

This document is divided into five parts: general information about the National Association for Research in Science Teaching (NARST), the 1995 NARST annual meeting program, abstracts of papers presented at this meeting, first authors' addresses, and a participant index. The 10 strands concerning science education are: (1) Learning: Students' Conceptions and Conceptual Change; (2) Learning: Classroom Contexts and Learner Characteristics; (3) Teaching; (4) Teacher Education; (5) Curriculum, Evaluation, and Assessment; (6) Cultural, Social and Gender Issues; (7) Educational Technology; (8) History, Philosophy and Epistemology; (9) Spanish Sessions (variety of types presented in Spanish); and (10) Other Informal Learning, Policy and Reform, Public Awareness, Research Methods, Teachers as Researchers, etc. (JRH)

****
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NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

Final Program and Abstracts

1995 NARST ANNUAL MEETING

Informal Learning in Science

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NATIONAL ASSOCIATION FOR RESEARCH IN SCIENCE TEACHING

Final Program and Abstracts

1995 NARST ANNUAL MEETING

Informal Learning in Science

April 22–25, 1995
Holiday Inn Golden Gateway Hotel
San Francisco

Authentic School Science

Knowing and Learning in Open-Inquiry Science Laboratories

by
Wolff-Michael Roth
Simon Fraser University, Burnaby, B.C., Canada

Book Highlight

According to John Dewey, Seymour Papert, Donald Schon, and Allan Collins, school activities, to be authentic, need to share key features with those worlds about which they teach. This book documents learning and teaching in open-inquiry learning environments, designed with the precepts of these educational thinkers in mind. The book is thus a first-hand report of knowing and learning by individuals and groups in complex open-inquiry learning environments in science. As such, it contributes to the emerging literature in this field. Secondly, it exemplifies research methods for studying such complex learning environments. The reader is thus encouraged not only to take the research findings as such, but to reflect on the process of arriving at these findings.
Finally, the book is also an example of knowledge constructed by a teacher-researcher, and thus a model for teacher-researcher activity.

Preface. **I: Background. I.1.** Introduction. **I.2.** General Theoretical Grounding. **I.3.** Setting. **II: Individual and Collaborative Construction of Knowledge. II.1.** Individual Construction of Knowledge. **II.2.** Individual Constructions. **II.3.** Learning as Situated Activity. **II.4.** Collaborative Constructions. **II.5.** Studies on Collaborative Concept Mapping. **II.6.** Tools for Social Thinking. **III: Framing and Solving Problems. III.1.** Overview of Problem-Solving Research. **III.2.** Problem-Setting. **III.3.** Teacher Effects in Problem Setting. **III.4.** Finding Solutions. **III.5.** Concrete Modes of Thinking. **IV: Interactions. IV.1.** Characteristics of Student-Student Interactions. **IV.2.** Interactional Processes. **IV.3.** Structure of Interactions. **IV.4.** Communities of Knowledge. **IV.5.** A Framework for Teacher-Student Interactions. **IV.6.** Apprenticeship in Science Classrooms. **IV.7.** Microanalyses of Cognitive Apprenticeship. Conclusion. Epilogue. Bibliography. Index.

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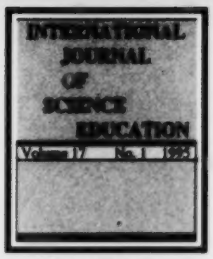

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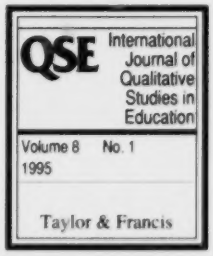

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Herbert J. Walberg, University of Illinois at Chicago, USA
Barry J. Fraser, Curtin University of Technology, Australia

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3: **Students' Conceptions and Constructivist Teaching Approaches**
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Theo Wubbels, University of Utrecht, The Netherlands

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Kenneth Tobin, Florida State University, USA

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Tjeerd Plomp, University of Twente, The Netherlands
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Léonie J. Rennie, Curtin University of Technology, Australia
Jan Harding, Alresford, England

10: **Cross-National Comparisons of Outcomes in Science Education**
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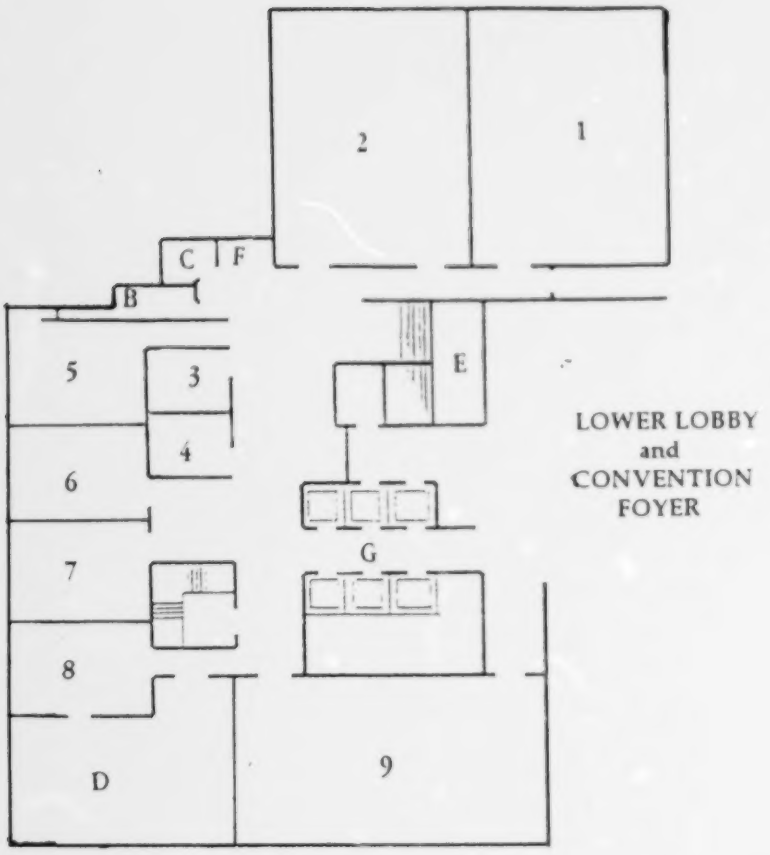
HOTEL LAYOUT

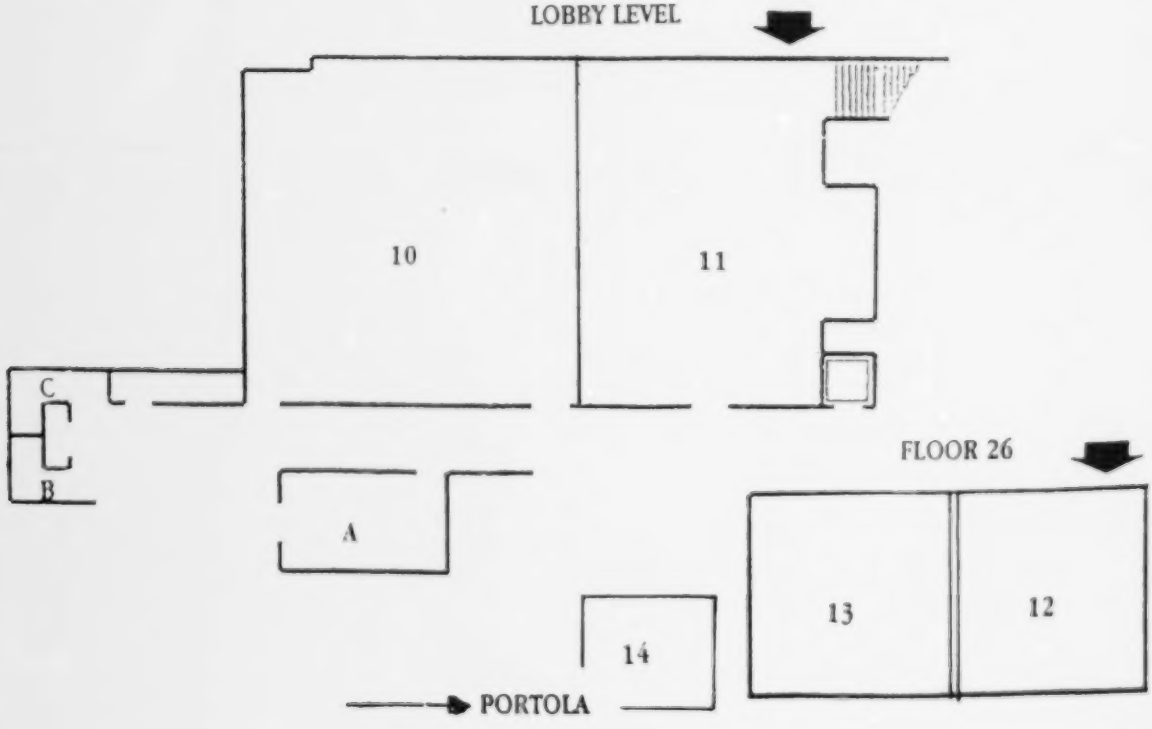


KEY — Rooms

Gold Rush B	1
Gold Rush A	2
Monterey	3
Carmel	4
Oregon	5
Nevada	6
Washington	7
California	8
Redwood	9
Emerald	10
Crystal	11
Suite 2601	12
Suite 2625	13
Portola	14

KEY — Facilities

NARST Executive Office	A
Women's Washrooms	B
Men's Washrooms	C
Sales & Catering Offices	D
Stairs to Lobby	E
Telephones	F
Elevators	G



Guidelines For Presiders

Paper Sets

- Go to designated room early. Arrange room furniture to suit the type of session. Check overhead projector and other audiovisual equipment.
- Meet and greet presenters and discussant (if assigned). Check the pronunciations of names and institutional affiliations.
- Agree on the order and time allotments for presentations, questioning and discussion.
- Urge audience to sit near front or to adjust to optimal seating pattern.
- Start session promptly. Also dismiss it on time.
- Hold presenters to the agreed time schedule. Hold up cards marked '3 minutes', '1 minute', 'Time is up!' Stand up if necessary.
- Adjust lamps and window shades for desired lighting. Leave door open to encourage late arrivals but close it if necessary.
- Adjust overhead projector if not focused or not framed on screen. Turn it off if not in continuous use. Assist with use of other AV equipment.
- Assist presenters to pass out their papers.
- Monitor questions. Keep questions, brief, civil and on the topic. Assure fair involvement.

Symposia

Discussion and questioning is controlled by the proposer with the assistance of the discussant (if designated). Discussion should promote the expression of alternative viewpoints and theoretical positions.

Discussion Groups

Discussion group presentations are quite informal and of short duration. Most of the session time is devoted to dialogue between presenters and audience and is usually monitored by the assigned discussant. The presider should negotiate these shorter presentation times with the presenters.

Round Tables

In round table sessions, each presenter is assigned a table and makes a short, informal presentation followed by discussion which he/she controls. Presider responsibilities:

- Help each presenter find and set up at the table assigned and identified by a member of the program committee.
- Assist audience participants to find the appropriate table.
- Give a five-minute warning of the session ending time.
- Dismiss on time.

Guidelines For Discussants

Read papers before the session. Interject new ideas and differing viewpoints. Make brief and cogent summary with suggestions for further research.

Acknowledgements

The 1995 NARST Annual Meeting Program and Abstracts book was prepared at Curtin University in Australia by the following members of the Program Committee:

Barry Fraser (Chair)
Sue Stocklmayer
Paul Joslin
Terry McClafferty
Bruce Waldrip
Geoff Giddings

Extensive and skilful wordprocessing support was provided by Laura Schranz and Trudy Tanner.

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PART A

General Information

Information about NARST

The National Association for Research in Science Teaching was founded in 1928 for the purpose of promoting research in science education at all educational levels and disseminating the findings of this research in such ways as to improve science teaching. The Association is incorporated as a non-profit corporation in the State of Minnesota. The official publication is the *Journal of Research in Science Teaching*.

NARST encourages the conduct and presentation of the results of a wide variety of investigations in all aspects of science education, including action, historical, philosophical, ethnographic, experimental and evaluative studies. Reports of empirical research, critical reviews and theoretical works are encouraged. Some research areas of interest to NARST members include curriculum development and organization, assessment and evaluation, learning theory, teacher education, programs for the talented and handicapped, equity studies and methods of teaching.

Current membership is about 1400, the highest ever. Approximately 20% are non-US, making NARST a truly international organization. Almost 65% have joined since 1990. Approximately 40% of the members attend the annual meetings.

The Association's headquarters are located with the office of the Executive Secretary. Inquiries regarding membership and other matters should be addressed to: Dr John Staver, NARST Executive Secretary, Bluemont Hall, Kansas State University, Manhattan, KS 66506-5313, USA. Telephone: 913-532-7688, Fax: 913-532-7304, E-Mail: staver@ksuvm.ksu.edu.

How NARST Keeps its Members Informed

- Ten issues of the *Journal of Research in Science Teaching* (JRST). The Journal has been ranked as one of the highest quality educational journals according to studies published by War, Holland and Schramm (*American Educational Research Journal*) and Guba and Clark (*Educational Researcher*) for the American Educational Research Association (AERA). These authors identified JRST as clearly the top research journal in science education.
- Abstracts of research papers presented at the annual meeting.
- Quarterly newsletter describing recent developments in research and in the profession. Opportunities to work with prominent people throughout the world on research projects and with such affiliated organizations as the National Science Teachers Association (NSTA) and the American Association for the Advancement of Science (AAAS).

NARST Outstanding Paper Award Submissions

Presenters wishing to have their papers considered for the 1995 Outstanding Paper Award must place one copy in the box marked "1995 NARST Outstanding Paper Award" located near the registration table at the 1995 Annual Meeting. In late April, the Chairperson will request that the first author send 8 copies of the paper with names and affiliations of all authors removed. Authors have six weeks to send in copies of their paper.

Address all correspondence to Joseph Krajcik, Chair of the NARST Outstanding Awards Committee, 1323 School of Education, 610 East University, University of Michigan, Ann Arbor, MI 48109-1259. Telephone: 313-747-0597, Email: krajcik@umich.edu.

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Explanation of Program Session Formats

SYMPOSIUM: A symposium presents a single important issue, controversial topic or area of research. One or more short presentations are made and summarized by a designated discussant. The discussant promotes and coordinates active debate and discussion among the participants.

PAPER SET: A paper set format consists of 3-5 research reports on the same or similar topic. Some sets are arranged by a proposer, others are grouped by the program committee. While audience discussion is important, most of the session time is devoted to presentations.

DISCUSSION GROUP: A discussion group format is similar to a paper set but the presentations are shorter and more informal. Most of the session time is for dialogue among presenters and participants.

ROUND TABLE: In this format, a single paper is presented informally to a small group seated at a round table. The purpose of this format is to promote more intimate discussion of the topic by those intensely interested in it.

POSTER: This format is a visual display of text, graphs, charts, photographs, etc. on a poster board with display space of 4 by 4 feet (1.2m by 1.2m). Presenters talk informally with participants who move among the displays.

OTHER: Other formats may include presentations by invited speakers, audiovisual demonstrations, debates, and others of a novel nature.

Strand Key

STRAND 1	Learning: Students' Conceptions and Conceptual Change
STRAND 2	Learning: Classroom Contexts and Learner Characteristics
STRAND 3	Teaching
STRAND 4	Teacher Education
STRAND 5	Curriculum, Evaluation and Assessment
STRAND 6	Cultural, Social and Gender Issues
STRAND 7	Educational Technology
STRAND 8	History, Philosophy and Epistemology
STRAND 9	Spanish Sessions
STRAND 10	Other: Informal Learning, Policy and Reform, Public Awareness, Research Methods, Teachers as Researchers, etc.

Technology/Resources Room

Portola

Following the success of the Technology/Resources Room at previous conferences, Nancy Songer (Educational Technology Strand Coordinator) will coordinate a similar room at the 1995 NARST annual meeting. The Technology/Resources Room will be housed in the Portola Room, although space stringency means that some strand sessions also will have to be scheduled in the same room. The Technology/Resources Room will provide conference participants with facilities for viewing videotapes and examining commercial computer software, as well as a place to meet to discuss issues in educational technology. Limited provisions for copying floppy disks also could be available.

A Special Thanks to Sponsors

John Wiley and Sons, Publishers, for their sponsorship of the JRST Editorial Board Meeting and Dinner.

Kluwer Academic Publishers, for their sponsorship of the Special Session for Past-Presidents, Executive Secretaries and Recipients of the Distinguished Contributions Through Research Award.

QANTAS Airways Limited, for their sponsorship of the Special Session *Science Theater "Archimedes: To Sink or Not to Sink" by Michael Gore.*

Publishers' Exhibits

At this year's NARST annual meeting, the following ten publishers will exhibit their books in the Lower Lobby:

- ***Elsevier Science Limited***
- ***ERIC Clearinghouse for Science, Mathematics, and Environmental Education***
- ***Kluwer Academic Publishers***
- ***Lawrence Erlbaum Associates, Inc., Publishers***
- ***Macmillan Publishing Company***
- ***National Science Foundation***
- ***NSSE (National Society for the Study of Education)***
- ***Physics Academic Software***
- ***Taylor & Francis/Falmer Press***
- ***Teachers College Press.***

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1996 NARST Annual Meeting

"Meet Me In St. Louis"

Program Chair Tom Koballa, Jr invites NARST members and others to plan to participate in the 1996 NARST annual meeting and especially urges all members to start planning program proposals now during this year's conference.

VENUE: Hyatt Regency St Louis at Union Station
One St Louis Union Station
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Telephone: 314-231-1234 Fax: 314-436-4238

DATES: **Sunday, 31 March to Thursday, 4 April 1996** immediately following the annual meeting of the National Science Teachers Association (28-31 March) in St Louis. AERA meets in New York City during April 8-12.

SUBMISSION DEADLINE: Program proposals for the 1996 annual meeting must be received by strand coordinators by **15 August 1995.** The deadline has been made earlier to allow more time for processing and evaluating the expected increase in the number of proposals. The call for proposals will appear in the June issue of *NARST News*.

FURTHER INFORMATION: Tom Koballa, Jr
Aderhold Hall, University of Georgia
Athens, GA 30602
Telephone: 706-542-1763 Fax: 706-542-1212 Email: tkoballa@uga.cc.uga.edu

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Future Meeting Dates for NARST, NSTA and AERA

1996	NSTA	St Louis	March 28-31
	NARST	St Louis	March 31-April 4
	AERA	New York City	April 8-12
1997	NARST	Chicago	March 21-24
	AERA	Chicago	March 25-29
	NSTA	New Orleans	April 3-6
1998	AERA	San Diego	April 14-18
	NSTA	Las Vegas	April 16-19
	NARST	Las Vegas	April 19-22
1999	NARST	Tentatively scheduled for Europe	

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Craig Bowen, University of Southern Mississippi

STRAND 2 — *Learning: Classroom Contexts and Learner Characteristics*
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STRAND 3 — *Teaching*
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Deborah Tippins, University of Georgia
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STRAND 5 — *Curriculum, Evaluation, and Assessment*
Jim Shymansky, University of Iowa

STRAND 6 — *Cultural, Social and Gender Issues*
Kate Scantlebury, University of Deleware

STRAND 7 — *Educational Technology*
Nancy Songer, University of Colorado

STRAND 8 — *History, Philosophy and Epistemology*
Norm Lederman, Oregon State University

STRAND 9 — *Spanish Sessions*
Alejandro Gallard, Florida State University

STRAND 10 — *Other (Informal learning, public awareness, etc.):*
Anita Roychoudhury, Miami University (Ohio)

Program Proposal Assessors

Program proposals were given blind reviews by a group of assessors which included members of the Program Committee and the following:

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University of Delaware

Deyanira Barnett
Universidad de Panamá

Bill Barowy
BBN Systems & Technologies

Kathy Black
University of Victoria

Bill Boone
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NARST Award Winners

Distinguished Contributions to Science Education Through Research Award

This award is given at the annual meeting but is bestowed only when a superior candidate is identified. It is given to recognize an individual who, through research over an extended period of time, has made outstanding and continuing contributions, provided notable leadership, and made a substantial impact in the area of science education.

Year	Awardee
1986	Anton E. Lawson
1987	Paul DeHart Hurd
1988	John W. Renner
1989	Willard Jacobson
1990	Joseph D. Novak
1991	Robert L. Shrigley
1992	Pinchas Tamir
1993	Jack Easley, Jr
1994	Marcia C. Linn

JRST Award

The JRST Award is given annually for the article published in the *Journal of Research in Science Teaching* during the previous year and judged to be the most significant for that year.

Year	Awardee
1974	Donald E. Riechard and Robert C. Olson
1975	Mary Budd Rowe
1976	Marcia C. Linn and Herbert C. Thier
1977	Anton E. Lawson and Warren T. Wollman
1978	Dorothy Gabel and J. Dudley Herron
1979	Janice K. Johnson and Ann C. Howe
1980	John R. Staver and Dorothy Gabel
	(tie) Linda R. DeTure
1981	William C. Kyle, Jr
1982	Robert G. Good and Harold J. Fletcher
	(tie) F. David Boulanger
1983	Jack A. Easley, Jr
1984	Marcia C. Linn
	Cathy Clement and Stephen Pulos
1985	Julie P. Sanford
1986	Anton E. Lawson
1987	Russell H. Yeany
	Kueh Chin Yap and Michael J. Padilla
1988	Kenneth G. Tobin and James J. Gallagher
	(tie) Robert D. Sherwood Charles K. Kinzer
	John D. Bransford and Jeffrey J. Franks
	(tie) Anton E. Lawson
1989	Glen S. Aikenhead
1990	Richard A. Duschl and Emmett L. Wright
1991	E. P. Hart and I. M. Robottom
1992	John R. Baird Peter J. Fensham
	Richard E. Gunstone and Richard T. White
1993	Nancy R. Romance and Michael R. Vitale
1994	E. David Wong

Outstanding Paper Award

The Outstanding Paper Award is given annually for the paper or research report presented at the annual meeting that is judged to have the greatest significance and potential in the field of science education.

Year	Awardee
1975	John J. Koran
1976	Anton E. Lawson
1977	no award
1978	Rita Peterson
1979	Linda R. DeTure
1980	M. James Kozlow and Arthur L. White
1981	William Capie Kenneth G. Tobin and Margaret Boswell
1982	F. Gerald Dillashaw and James R. Okey
1983	William C. Kyle, Jr James A. Shymansky and Jennifer Alport
1984	Darrell L. Fisher and Barry J. Fraser
1985	Hanna J. Arzi Ruth Ben-Zvi and Uri Ganiel (tie) Russell H. Yeany Kuch Chin Yap and Michael J. Padilla
1986	Barry J. Fraser Herbert J. Walberg and Wayne W. Welch
1987	Robert D. Sherwood
1988	Barry J. Fraser and Kenneth G. Tobin
1989	James J. Gallagher and Armando Contreras
1990	Patricia L. Hauslein Ronald G. Good and Catherine Cummins
1991	Nancy R. Romance and Michael Vitale
1992	Patricia Heller Ronald Keith and Scott Anderson
1993	Wolff-Michael Roth
1994	Wolff-Michael Roth and Michael Bosen

Outstanding Doctoral Dissertation Award

This award was established in 1992 to be given annually for the doctoral dissertation judged to have the greatest significance in the field of science education.

Year	Awardee	Major Professor
1992	Rene Stofflett	Dale Baker
1993	Julie Gess-Newsome	Norman Lederman
1994	Carolyn W. Keys	Burton Voss

Early Career Research Award

The Early Career Research Award is given annually to the early researcher (the recipient will have received his/her doctoral degree within five years of receiving the award) who demonstrates the greatest potential to make outstanding and continuing contributions to educational research.

Year	Awardee
1993	Wolff-Michael Roth
1994	Deborah J. Tippins

Classroom Applications Award

The Classroom Applications Award was established in 1979. The award was given annually to authors whose papers were presented at the previous annual meeting and judged to be outstanding in terms of emphasizing classroom application of research in science education. The award was presented for the last time in 1991.

Year	Awardee
1980	Livingston S. Schneider and John W. Renner
Five Equal Awards	Heidi Kass and Allan Griffiths
	Ramona Saunders and Russell H. Yeany
	Joe Long, James R. Okey and Russell H. Yeany
	M. James Kozlow and Arthur L. White
1981	Dorothy Gabel, Robert D. Sherwood and Larry G. Enochs
Four Equal Awards	Wayne Welch, Ronald D. Anderson and Harold Pratt
	Mary Ellen Quinn and Carolyn Kessler
	P. Ann Miller and Russell H. Yeany
1982	Louise L. Gann and Seymour Fowler
Four Equal Awards	Dorothy L. Gabel and Robert D. Sherwood
	Thomas L. Russell
	Joseph C. Cotham
1983	Robert D. Sherwood, Larry G. Enochs and Dorothy Gabel
1984	Mary Westerback, Clemencia Gonzales and Louis H. Primavera
Four Equal Awards	Kenneth G. Tobin
	Hanna J. Arzi, Ruth Ben-Zvi and Uri Ganiel
	Charles Porter and Russell H. Yeany
1985	Dan L. McKenzie and Michael J. Padilla
Three Equal Awards	Margaret Walkosz and Russell H. Yeany
	Kevin C. Wise and James R. Okey
1986	Sarath Chandran, David F. Treagust and Kenneth G. Tobin
Four Equal Awards	Darrell L. Fisher and Barry J. Fraser
	Dorothy L. Gabel, Stanley L. Helgeson, Joseph D. Novak, John Butzow and V. K. Samuel
	Linda Cronin, Meghan Tweist and Michael J. Padilla
1987	Dorothy L. Gabel, V. K. Samuel, Stanley L. Helgeson, Saundra McGuire, Joseph D. Novak and John Butzow
1988	Uri Zoller and Benn Chaim
1989	James D. Ellis and Paul J. Kuerbis
1990	Dale R. Baker, Michael D. Piburn and Dale S. Niederhauser
1991	Carl F. Berger, Billie Jean Edwards and David F. Jackson

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PART B

Annual Meeting Program

SATURDAY April 22

Program Overview

Session	Room	Time
Registration	LOBBY	8.00 am – 8.00 pm
Executive Board Meeting	MONTEREY	8.00 am – 4.00 pm
Preconference Tours		
Napa and Sonoma Valleys		8.30 am – 3.00 pm
City of San Francisco		9.00 am – 12.30 pm
Presession Workshops		
Policy Relevant Science Education Research Gary Sykes (Michigan State University)	GOLD RUSH A	9.30 am – 12.00 pm
The Evolution of Teachers' Sociocognitive Models of Classroom Praxis: An Innovative Method for Research and Supervision Lon Richardson (University of Northern Kentucky) & Patricia Simmons (University of Georgia)	GOLD RUSH B	1.00 pm – 3.30 pm
General Session		
The Many Faces of Constructivism **Denis Phillips (Stanford University)**	**EMERALD**	**4.00 pm – 5.30 pm**
Next Generation of Researchers' Orientation (including international members)	REDWOOD	6.00 pm – 7.00 pm
***JRST* Editorial Board Meeting and Dinner**	OREGON	5.30 pm – 8.30 pm
STRAND SESSION		7.00 pm – 8.30 pm
Reception for New Members, including Poster Session	EMERALD	8.30 pm – 10.00 pm

SATURDAY April 22

Strand Highlights

Sponsor	Session	Time & Room
STRAND 5	*The Collaborative Development of Science Assessments: The SCASS Experience* Edward D. Roeber, Charles Warren, Jeff Greig, Dan Ochs, Rolf Blank, Megan Martin	7.00 pm – 8.30 pm GOLD RUSH B
STRAND 10	*International Encyclopedia of Education (Second Edition): Process and Product* Torsten Husén (University of Stockholm, Sweden) John P. Keeves (Flinders University of South Australia, Australia) Herbert J. Walberg, Daoxin Lu, Yu-Fen Chang (University of Illinois at Chicago)	7.00 pm – 8.30 pm GOLD RUSH A

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4:00PM — 5:30PM GENERAL SESSION SATURDAY 22 APRIL

The Many Faces of Constructivism

Presider: *Barry J. Fraser, Curtin University, Australia* — **Emerald**
Speaker: *Denis C. Phillips, Stanford University*

7:00PM — 8:30PM STRAND SESSION SATURDAY 22 APRIL

Assessment Embedded in Science Teaching and Learning (3 Teaching : Interactive Symposium)

Presider: *James J. Gallagher, Michigan State University* — **Nevada**
Discussant: *Joyce Parker, Michigan State University*
Participants:
James J. Gallagher, Joyce Parker, Michigan State University; David Treagust, Curtin University; Roberta Jacobowitz, Otto Middle School; Janet Luallen, Robinson Junior High School; Greg Hill, Holmes Middle School

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Science Is: Understanding Planet Earth (5 Curriculum, Evaluation and Assessment : Interactive Symposium)

Presider: *Victor J. Mayer, Ohio State University* — **Washington**
Participants:
Victor J. Mayer, Rosanne Fortner, Tung-Huang Hsueh, Ohio State University; Mark Maley, Linworth Alternative School; Ronald Pilatowski, Bexley City School District; Dan Jax, Bexley City Schools; Melinda Wilder, Eastern Kentucky State University; Richard W. Pontius, State University of New York

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The Collaborative Development of Science Assessments: The SCASS Experience (5 Curriculum, Evaluation and Assessment : Interactive Symposium)

Presider: *Allen Doolittle, American College Testing Service* — **Gold Rush B**
Discussant: *Megan Martin, California Department of Education*
Participants:
Edward D. Roeber, Council of Chief State School Officers; Charles Warren, Ohio Department of Education; Jeff Greig, Connecticut Department of Education; Dan Ochs, Kentucky Department of Education; Rolf Blank, CCSSO

An Equity Blueprint for Science Education Reform (6 Cultural, Social and Gender Issues : Interactive Symposium)

Presider: *Sharon Lynch, George Washington University* — **California**
Discussant: *James Rutherford, American Association for the Advancement of Science*
Participants:
Sharon J. Lynch, George Washington University; Jacquelynne Eccles, University of Michigan; Mary Atwater, University of Georgia; Okhee Lee, University of Miami; Abbie Willetto, American Indian Science and Engineering Society; Jack Cauley, University of Buffalo; Doreen Rojas-Medlin, Daughterly County Board of Education

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Project 2061 Research Blueprint (10 Others : Interactive Symposium)

Presider: *Ron Good, Louisiana State University* — **Crystal**
Discussant: *Andrew Ahlgren, Project 2061*
Participants:
Ron Good, Louisiana State University; Charles Anderson, Michigan State University; Kathleen Fisher, San Diego State University; Dorothy Gabel, Indiana University; Larry Yore, University of Victoria; Norman Lederman, Oregon State University; James Shymansky, University of Iowa; James Wandersee, Louisiana State University

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Learning Through a Variety of Strategies (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Presider: *Christopher Burke, University of Illinois* — **Portola**

The Effects of Journal Writing in Secondary Physics
Susan Keiffer-Barone, John Rowe, Barbara Groene, University of Cincinnati

Self-explanations Promote Science Learning
Mei-Hung Chiu, National Taiwan Normal University, Taiwan

The Effect of Concept Mapping on Achievement in Grade 7 Biology
Iris T. Huang, Hsiang-ju Wang, National Kaohsiung Normal University, Taiwan

A Lakatosian Conceptual Change Teaching Strategy Based on Student Ability to Build Models with Varying Degrees of Conceptual Understanding of Chemical Equilibrium
Mansoor Niaz, Universidad de Oriente, Venezuela

Gender and Equity: Middle School Perspectives (6 Cultural, Social and Gender Issues : Paper Set Grouped by Committee)

Presider: *John Wallace, Curtin University* — **Monterey**

African-American Students' Opportunities to Learn Science: The Role of Middle School Scheduling
Mary Antony, University of Michigan; David F. Bair, Skidmore College

The Effects of Participation in a Math and Science Mentorship and Career Awareness Program on Middle School Girls
Stacey E. Marlow, University of Hawaii at Manoa, Michael P. Marlow, University of Colorado
Science and More: For Middle School Girls Only
Sheila F. Pirkle, Louisiana State University, Judith Brun, Linda Rausch, Mary-Ellen Jacobs, St Joseph's Academy

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Aspectos de la Física (9 Spanish Sessions : Paper Set Grouped by Committee)
Presider: *Carlos A. Reyes-García, Instituto Tecnológico de Apizaco, Mexico* — **Suite 2601**
La Ensenanza de la Fisica en la Formacion de Profesionales en Docencia de la Biologia
Maria Francia Cabrera-Castro, Constanza Castaño-Cuellar, Universidad Pedagógica Nacional, Colombia
Consecuencias Didacticas del Perfil Epistemologico del Concepto Cuerpo en la Obra Newtoniana
Maria Barrera de Aragón, Pontificia Universidad Javeriana, Colombia
Problemas de Fisica de la Vida Cotidiana
Michel Valero, Universidad del Valle, Colombia

Informal Science Learning (10 Others : Paper Set Grouped by Committee)
Presider: *Saouma Boujaude, American University of Beirut* — **Suite 2625**
Motivation and Social Cognitive Development in Informal Science Education Environments: A Developmental Study
Eric J. Pyle, University of Georgia
School-Museum Learning: Integrating New Approaches
Janette Griffin, University of Technology, Sydney, Australia
The Gap between the Public Perception of Science and the Realities of Science
Jane Johnston, Nottingham Trent University, England
Science Center Education: Motivation and Learning in Informal Education
Hannu S. Salmi, University of VASSA, Finland

Investigations into Teaching and Learning Through a Teacher Education Program (4 Teacher Education : Paper Set Grouped by Proposer)
Presider: *Angelo Collins, Florida State University* — **Oregon**
Discussant: *Kathleen O'Sullivan, San Francisco State University*
Teachers' Struggle to Articulate Their Learning Theories: A Window into Teaching and Learning
Sam Spiegel, Angelo Collins, Florida State University
The Use of Videotapes and Practical Inquiry in Promoting Teacher Change
Alejandro Gallard, Bradford Lewis, Florida State University
A Performance-based Instructional Technology Course for Practicing Middle Grades Science Teachers: The Rewards and Challenges
Cindy L. Doherty, Florida State University
Middle School Teachers Learning the Nature and Content of Science Through Scientific Research
Nancy T. Davis, Penny J. Gilmer, Sam Spiegel, Florida State University
Teacher Conceptualizations of Science: Help or Hindrance for Improving Middle Grades Science Teachers' Classroom Practice?
Elizabeth A. Viggiano, Florida State University

Science Self-efficacy Beliefs Research (4 Teacher Education : Paper Set Grouped by Proposer)
Presider: *Larry Scharmann, Kansas State University* — **Redwood**
The Development and Partial Validation of the Beliefs About Learning Science Instrument: A Measure for Secondary Students
Larry Enochs, University of Wisconsin-Milwaukee, Richard Audet, Boston University
Impact of Methods Courses on Preservice Elementary Teachers' Science and Mathematics Teaching Efficacy
DeAnn Huinker, University of Wisconsin-Milaukee, Sandra Madison, University of Wisconsin, Stevens Point
An Examination of Interview and Self-report Measures of Elementary Teachers' Self-efficacy in Teaching Science
Russell Yeany, J. Steve Oliver, B. Kim Nichols, Renna Calvert, University of Georgia, M. Janice French, Kansas State University
Origins of and Changes in Preservice Teachers' Science Teaching Self-efficacy
James Watters, Ian Ginns, Queensland University of Technology, Australia
The Characteristics of High and Low Efficacy Elementary Teachers
Iris M. Riggs, California State University, San Bernardino

International Encyclopedia of Education (Second Edition): Process and Product (10 Others : Paper Set Grouped by Proposer)
Presider: *Audrey Champagne, State University of New York at Albany* — **Gold Rush A**
International Encyclopedia in Historical Perspective
Torsten Husén, University of Stockholm, Sweden
Advances in Research Methodology
John P. Keeves, Flinders University of South Australia, Australia
Education's Big Ideas: Content Analysis of the Encyclopedia
Herbert J. Walberg, Daoxin Lu, Yu-Fen Chang, University of Illinois at Chicago

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8:30PM — 10:00PM RECEPTION & POSTER SESSION SATURDAY 22 APRIL

Emerald

1 Learning: Students' Conceptions & Conceptual Change

Textbook and Laboratory Centered Lessons: The Relationship to Development and Use of Scientific Models
Constance Haack, University of Oklahoma

Can Information Processing Approaches to Learning be Informed by Vygotskian Theory? Potential Interactions
Thomas M. Mastrilli, University of Pittsburgh

The Effects of Problem Context and Gender on Students' Proportional Reasoning Ability
Ayo H. Akatugba, Curtin University, Australia

A Comparison Study of the Learning Cycle and a Traditional Instructional Sequence in Teaching an Eighth Grade Science Topic
David J. Hedgepeth, Dennis W. Sunal, University of Alabama

Spatial Abilities of High School Students in the Perception of Geological Structures
Yael Kali, Nir Orion, Weizmann Institute of Science, Israel

The Development of Classification Structures within the Period of Concrete Operational Thought
Caroline S. Kybl, University of St Thomas

A Study of the Use of the Concept of Function Among University Students of the Natural Sciences
Guadalupe T. de Castillo, Jorge E. Hernandez, Universidad de Panama, Panama

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2 Learning: Classroom Contexts and Learner Characteristics

The Transformation of Individual and Collective Knowledge in Elementary Science Classrooms that are Organized as Knowledge-building Communities
Michelle K. McGinn, Wolff-Michael Roth, Simon Fraser University

Translating the Reading of Scientific Prose into Thinking and Understanding
Iona Wesso, University of The Western Cape, South Africa

Conceptual Change Based on Laboratory Experience
Robert E. Bleicher, Queensland University of Technology, Australia

Spatial Perception Skills of Chemistry Students
Sharon L. Coleman, Southeast Missouri State University; Al Golch, Benedictine College

The Relationship Between Formal Operational Thinking Ability and Prospective Grade Level to be Taught for Preservice Education Majors
Scott B. Watson, Juliana R. Baker, East Carolina University

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3 Teaching

Practicability of Constructivist Approaches in Science Teaching: A Case Study of Six Science Teachers in Taiwan
Chorng-Jee Guo, Wu-Hsiung Chiang, Mei-Ling Chen, Chun-Yuan Wang, National Changhua University of Education, Taiwan

The Development of Beginning Chemistry Teachers' Teaching Techniques
Huann-Shyang Lin, National Kao-Hsiung Normal University, Taiwan

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4 Teacher Education

Teachers' Perceptions of the Relative Importance of Science Methods Course Topics
Bambi L. Bailey, William Letts, Kathryn Scantlebury, University of Delaware

Preservice Teachers' Performance on a Projectile Motion Teaching Sequence: Research into Practice
Ian Ginns, James Watters, Queensland University of Technology, Australia

Using Video to Evoke Reflection on Science Teaching: BSCS Teacher Development Modules for Elementary School Science
Kathrine A. Backe, James D. Ellis, Biological Sciences Curriculum Study

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5 Curriculum, Evaluation and Assessment

A Strategy for Assessing Changes in Teachers Participating in an Enhancement Project
James A. Shymansky, Jennifer Childse, John Dunkbase, Deborah Dunkbase, Laura Henriques, Ibrahim Al-Momani, Eric Olson, Courtney Veronesi, University of Iowa; Margaret Jorgensen, Educational Testing Service; Thomas Koballa, Jr, University of Georgia

Intrinsic Motivation During a Summer Science Program for Academically Talented High School Students
Paul Tuss, Argonne National Laboratory

Effectiveness of a Participatory Learning Program for College Students in High-risk Science and Mathematics Courses
Kenneth W. Gattis, North Carolina State University

Evaluations in the Life in the Universe Curriculum Development Project
Kathleen A. O'Sullivan, San Francisco State University

Teachers' Thinking about Classroom Teaching: Resistance to the Concepts of a "National Curriculum" in Environmental Studies/Science
Sally Brown, University of Stirling, Scotland

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6 Cultural, Social and Gender Issues

Talking about Science: Perspectives of Hispanics about Identity, School Science and Scientific Knowledge
Constanza Hazelwood, Michigan State University

The Influence of Race, Ethnicity, Gender and Grade Level on Acceptance of Evolutionary Theory among Secondary Science Students
Corey S. Woods, Lawrence C. Scharmann, Kansas State University

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7 Educational Technology

A Pilot Study of an Electronic Community of Interdisciplinary Secondary Science Teachers
Mary E. Caggiano, R. Audet, Gerald L. Abegg, Boston University

Kepler's Laws: An Example of the Integrated Teaching of Mathematics and Physics Using the Computer as a Tool
Estela Navarro, Araceli Reyes, Maria Trigueroa, Centro Latinoamericano de Investigación, Mexico

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10 Others

Attributes of Research Technology Proposals for Elementary Science
Lloyd H. Barrow, University of Missouri, Columbia; Coralee Smith, Dakota State University; Joe Curran, Optical Data Corporation

Beginning Collaborative Action Research in Two High Schools: The Story of SS&C Reform in North Carolina
Frank E. Crawley, East Carolina University

SUNDAY April 23

Program Overview

Session	Room	Time
Committee Meetings		7.00 am – 8.30 am
STRAND SESSION		8.30 am – 10.00 am
STRAND SESSION		10.30 am – 12.00 pm
Lunch		12.00 pm – 1.00 pm
STRAND SESSION		1.00 pm – 2.30 pm
STRAND SESSION		2.45 pm – 3.45 pm
STRAND SESSION		4.00 pm – 5.30 pm
Invited Session for Past Presidents, Distinguished Contributions Awardees and Executive Secretaries (Hosted by NARST Board & Sponsored by Kluwer Academic Publishers)	NARST PRESIDENT'S SUITE	4.00 pm – 5.30 pm
Evening at the Exploratorium, Buffet Dinner and Poster Session		**6.00 pm – 9.30 pm (Buses depart at 6.00 pm and 6.30 pm)**

Strand Highlights

Sponsor	Session	Time & Room
STRAND 7	*NARST-net: A Training and Discussion Session* Derrick Lavoie (University of Northern Iowa) Joe Peters (University of West Florida)	8.30 am – 10.00 am PORTOLA
STRAND 8	*Can There Be a Universal Science in Our Multicultural World?* Norman Lederman, Mary Atwater, Nancy Brickhouse, William Stanley, Cathleen Loving, Denis Phillips, Ron Good	8.30 am – 10.00 am CRYSTAL
STRAND 2	*Exploring Scientific Activity and Students' Conceptions as They Engage in It* Joe Becker, Maria Varelas, Leona Schauble, Richard Lehrer, Lori Kurth, Charles Anderson, Annemarie Palincsar, Richard Duschl, Leslie Petasis, Kathleen Roth	10.30 am – 12.00 pm GOLD RUSH A

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SUNDAY April 23

Strand Highlights

Sponsor	Session	Time & Room
INTERNATIONAL COMMITTEE	*Factors Affecting Student Choice of Career in Science in Australia, Canada, China, England, Portugal and Japan* Brian Woolnough, Deidra Young, Barry Fraser, Carolyn Montgomery, Joanne Tims, Jim Gaskell, Gaalen Erickson, Zhen Wang, Tae Ryu, Miyuki Tanaka, Chiyoko Yuki, Hiroyoshi Kinoshita, Kazuhino Akao	10.30 am – 12.00 pm CRYSTAL
STRAND 10	*"Improving Science Education: International Perspectives": A Book Sponsored by the International Academy of Education* Barry Fraser, Herbert Walberg, Avi Hofstein, John Keeves, Lesley Parker, Léonie Rennie, David Treagust, Reinders Duit	10.30 am – 12.00 pm EMERALD
STRAND 7	*Computer as Learning Partner: A Retrospective, Parts I & II* Marcia Linn, Phil Bell, Helen C. Clark, Elizabeth Davis, Brian Foley, Christopher Hoadley, Sherry Hsi, Eileen Lewis, Jacquie Madhok, Lawrence Muilenberg, Dawn Rickey, Judy Stern, Rick Weinland, Carl Berger, Joe Krajcik, Nick Burbules, Bat Sheva Eylon, Doug Kirkpatrick, John Layman, Jim Minstrell, Rafi Nachmias, Yael Friedler, Roy Pea, Nancy Songer, Bob Tinker	12.30 pm – 2.30 pm 2.45 pm – 3.45 pm CRYSTAL
STRAND 1	*When Models and Analogies Go Wrong* David Treagust, Shawn Glynn, John Gilbert, Allan Harrison, Grady [illegible]ville, Sue Stocklmayer, Rod Thiele	1.00 pm – 2.30 pm EMERALD
STRAND 3	*Toward an Understanding of Science Teacher Development: A Focus on Interpretive Case Study Research* Richard Powell, Elizabeth Charron, Tom Dana, Nancy Dana, Anita Roychoudhury, Deborah Tippins, Ken Tobin	1.00 pm – 2.30 pm GOLD RUSH A
STRAND 9 (Spanish Session)	*Constructivismo y Perspectivas Culturales* Carlos Alberto Reyes-García, Ramón Alberto Mata-Toledo, Alfonso Suárez-Gómez, Fernando Molina, V. Vargas, F. Daza, Lilia Reyes-Herrera, Gloria Jiménez	1.00 pm – 2.30 pm WASHINGTON
STRAND 6	*Minorities and the Teaching and Learning of Science* John Ogbu (University of California, Berkeley)	2.45 pm – 3.45 pm EMERALD
STRAND 7	*The Thinker Tools II Project: A Computer-Based Curriculum* Barbara White (University of California, Berkeley) John Frederiksen (Educational Testing Service)	2.45 pm – 3.45 pm PORTOLA
INTERNATIONAL COMMITTEE	*Recent Trends in European Science Education Research* Reinders Duit, Rosalind Driver, John Gilbert, Richard Duschl, Philip Adey, Theo Wubbels, Onno de Jong, Fred Korthagen, Peter Hewson	4.00 pm – 5.30 pm EMERALD

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7:00AM — 8:30AM COMMITTEE MEETINGS SUNDAY 23 APRIL

Distinguished Contributions to Science Education Through Research Award Committee — Gold Rush A
Presider: *Cheryl Mason, San Diego State University*

JRST Award Committee — Gold Rush B
Presider: Kathleen Roth, Michigan State University

Outstanding Paper Award Committee — Redwood
Presider: *Joseph Krajcik, University of Michigan*

Early Career Research Award Committee — Oregon
Presider: *Audrey Champagne, SUNY at Albany*

Outstanding Doctoral Dissertation Award Committee — California
Presider: *Russell Yeany, University of Georgia*

Outstanding Master's Thesis Award Committee — Nevada
Presider: *Angelo Collins, Florida State University*

8:30AM — 10:00AM STRAND SESSION SUNDAY 23 APRIL

Students' Alternative Conceptions: An International Perspective (1 Learning: Students' Conceptions & Conceptual Change : Discussion Group) — Redwood
Presider: *David Brown, University of Illinois*

Pupils' Commonsense Ideas about the Construction of Knowledge
Maria C. Mariani, São Paulo University, Brazil

Withdrawing the Taboo Regarding Anthropomorphism and Teleology in Biology Education: Heretical Suggestions
Shlomit Ginossar, Hebrew University of Jerusalem, Israel; Anat Zohar, Technion — Israel Institute of Technology, Israel

Ambiguous Chemical Terms: A Source for Students' Misconceptions
Hans-Jürgen Schmidt, University of Dortmund, Germany

Framework of Student Conceptions Concerning Gravity
Christopher Burke, Rene Stofflett, University of Illinois

Visual Learning Symposium (1 Learning: Students' Conceptions & Conceptual Change : Interactive Symposium) — Gold Rush A
Presider: *Loretta Jones, University of Northern Colorado*
Participants:
Loretta Jones, University of Northern Colorado; Marcia Linn, University of California at Berkeley, Bob Sherwood, Vanderbilt University; Janet Bohren, University of Cincinnati, Dorothy Gabel, Indiana University; Carl Berger, University of Michigan

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Exploring the Role of Self in Science and Science Education: Feminist Perspectives and Women's Stories (6 Cultural, Social and Gender Issues : Interactive Symposium) — Gold Rush B
Presider: *Kathleen J. Roth, Michigan State University*
Discussants: *Deborah Trumbull, Cornell University; Deborah Tippins, University of Georgia, Sherry Nichols, University of Texas, Austin*
Participants:
Kathleen J. Roth, Angela Barton, Constanza Hazelwood, Lori Kurth, Elaine Oren, Gail Richmond, Deborah Smith, Michigan State University; Lynne Cavazos, University of California, Santa Barbara

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NARST-net: A Training and Discussion Session (7 Educational Technology) — Portola
Presider: *Mark Williams, Edith Cowan University, Australia*
Presenters:
Derrick R. Lavoie, University of Northern Iowa; Joe Peters, University of West Florida

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Can There Be a Universal Science in Our Multicultural World? (8 History, Philosophy and Epistemology : Interactive Symposium) — Crystal
Presider: *Paul Joslin, Drake University*
Discussant: *Norman Lederman, Oregon State University*
Participants:
Norman G. Lederman, Oregon State University; Mary Atwater, University of Georgia; Nancy Brickhouse, William Stanley, University of Delaware; Cathleen Loving, Texas A & M University; Denis Phillips, Stanford University; Ron Good, Louisiana State University

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Discourse in Elementary Schools (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee) — Oregon
Presider: *Craig Berg, University of Wisconsin*

Explicit Science Reading Instruction in Grade 7: Metacognitive Awareness, Metacognitive Self-management and Science Reading Comprehension
Larry D. Yore, University of Victoria; David J. Spence, John Stubbs Memorial School; Richard L. Williams, University of Victoria

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Promoting Loud Thinking about Light in Elementary School Science
Gilda Segal, Mark Cosgrove, University of Technology, Sydney, Australia
Evolution of a Model for Teaching In-depth Science in Elementary Schools: Longitudinal Findings and Research Implications
Michael R. Vitale, East Carolina University; Nancy R. Romance, Florida Atlantic University
A Vygotskian Perspective on Discourse in a Seventh Grade Science Class in an Urban South African School
Elizabeth Henning, Johan Strauss, Rand Afrikaans University, South Africa

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Teachers' Subject Matter Knowledge and Content Structure (3 Teaching : Paper Set Grouped by Committee)
Presider: *Obed Norman, Washington State University* — **Nevada**
Implementation of Inquiry-based Tutorials in an Introductory Physics Course: The Role of the Graduate Teaching Assistant
Carol W. Thoresen, Montana State University
Biology Teachers' Knowledge Base of Instructional Representations
Sheau-Wen Lin, Jong-Hsiang Yang, National Taiwan Normal University, Taiwan
The Influence of Curriculum Development on Teachers' Representations of Subject Matter Structure
Julie Gess-Newsome, University of Utah
Three Beginning, Urban, Secondary Science Teachers' Evolving Understanding of the Nature of Science
Susan Ralston, Ruth Bombaugh, John Sowder, Hans Sowder, University of Michigan

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Teachers and Technology (4 Teacher Education : Paper Set Grouped by Committee)
Presider: *John Sode, North Dakota State University* — **Washington**
Factors Influencing the Use of Internet Communities for Secondary Science Teacher Enhancement
William Barowy, Catalina Laserna, Bolt Beranek & Newman Inc.; Barry Saferstein, University of California
Investigating the Process of Becoming Reflective: The Use of Video Cases in Elementary Science Teacher Preparation
Sandra K. Abell, Lynn A. Bryan, Maria Anderson, Purdue University; Lois M. Campbell, Pennsylvania State University; Katherine S. Cennamo, Purdue University; J. William Hug, Pennsylvania State University
A Survey of Telecommunications Use by Secondary School Science Teachers in New York City
Brian Murfin, Queens College of the City University of New York
A Description and Analysis of Techniques Involving an Interactive Video Lab School for Science Teacher Education
Allan MacKinnon, Simon Fraser University

Evaluation of Curriculum and Instruction (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)
Presider: *Debra Tomanek, North Dakota State University* — **Monterey**
Gulf Literacy: A Marine Science-based Model of Scientific Literacy
John Trowbridge, Southeastern Louisiana University; James H. Wandersee, Louisiana State University
The Effect of Within-test and Between-tests Teaching Interventions to Help Subjects to Attend to the Logical Structure of Scientific Situations
Ehud Jungwirth, Hebrew University of Jerusalem, Israel
A Comparison of the Effects of Multiple Visual Examples and Nonexamples versus Prototypical Examples on Science Concept Learning
Eleanor D. Abrams, University of New Hampshire; James H. Wandersee, Louisiana State University
The Effect of Teaching the Cell Topic Using the Jigsaw Method on Students' Achievement and Learning Activity
O. Yeroslavski, Yehudit J. Dori, R. Lazarowitz, Technion — Israel Institute of Technology, Israel

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International Perspectives on School and College Students (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)
Presider: *James O'Non, Maharishi International University* — **Suite 2625**
The Nature and State of General Chemistry Laboratory Courses Offered by Colleges and Universities in the United States
Michael R. Abraham, University of Oklahoma; Mark S. Cracolice, University of Montana; A. Palmer Graves, Abdulwali H. Aldahmash, Joann G. Kibega, Julieta Palma Gil, Valsamma Varghese, University of Oklahoma
How Would You Know if Your Science Education Reform is a Success? Developing Science Indicators at the School District Level
Graham Orpwood, York University; Erminia Pedretti, University of British Columbia
Undergraduate Non-Science Majors' Evaluations of Geology Labs
William J. Boone, Indiana University
Teaching Biodiversity: Results of a Delphi Study in Germany
Jürgen Mayer, University of Kiel, Germany

Equity Issues in Science Education (6 Cultural, Social and Gender Issues : Paper Set Grouped by Committee)
Presider: *Jerome Shaw, Stanford University* — **Suite 2601**
Learning Styles of African American Children and NSTA Goals of Instruction
Claudia T. Melear, Beth Broadhurst, East Carolina University
Reviewing Gender and Science Education via Multiple Frames of Reference
Gaell Hildebrand, University of Melbourne, Australia
Attitudes of Junior and Senior High School Students toward Science and Math
Eileen D. Bunderson, Brigham Young University

Different Modes of Assessment in Science and Mathematics: A Systematic Interaction with Gender
Wesley H. Parker, Joanne E. Tims, Curtin University, Australia

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Learning on Field Trips to Interactive Science Centers and Zoos (10 Others : Paper Set Grouped by Committee)

Presider: *Darrell Fisher, Curtin University* — **California**

Interactive Science Exhibits on Color Concepts: Testing an Educational Design Model
Bernadette M. Peiffer, SciTrek; Edward Lucy, Georgia State University

The Effectiveness of Orienting Students to the Physical Features of a Science Museum Prior to Visitation
David Anderson, Kelvin Grove High School, Australia; Keith Lucas, Queensland University of Technology, Australia

The Effects of Pre-trip Programs on Learning from a Single-visit Zoo Field Trip
John D. Balling, Dickinson College; John H. Falk, Science Learning Inc

Girls' and Boys' Use of Interactive Science Museums
Teresa Arámbula-Greenfield, University of Hawaii

POSTERS — **EMERALD**

2 Learning: Classroom Contexts and Learner Characteristics

Learning Environment and Academic Achievement of High School Students Who Learned Evolution in a Cooperative Mode
Salit Ron, Reuven Lazarowitz, Technion – Israel Institute of Technology, Israel

Focusing Students' Attention to Videotaped Analogies Using Questions
Laura M. Barden, University of Tennessee; William J. Kermis, Oklahoma State University; William G. Holliday, University of Maryland

An Investigation of Collaboration in a Project-based Science Middle School Classroom
Barbara A. Crawford, University of Michigan

The Interactions of Spatial Perception, Spatial Orientation and Spatial Visualization with Achievement in Microbiology
Alan Lennon, Margaret E. Heimbrook, April L. Gardner, University of Northern Colorado

Personal and Social Sense-making: Learning Science in the Junior High School Classroom
Sandra J. Finley, University of Texas at Austin; Frank E. Crawley, East Carolina University

Investigating the Origins of Teachers' Attitudes Toward Teaching Elementary Science
Richard Spiller, Pierce Farragher, University of Victoria

The Impact of Learned-helplessness on Students: Student Interactions in Cooperative Learning Groups in High School Physics
Julie Cook, Ohio State University, Lima; Lloyd Barrow, University of Missouri, Columbia

Utilizing Feedback Data on Students' Perceptions of Teaching Style and Preferred Learning Style to Enhance Teaching Effectiveness
John D. Woods, Edith Cowan University, Australia; Barry J. Fraser, Curtin University, Australia

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3 Teaching

Complex Instruction in Complex Classrooms: A Synthesis of Research on Inquiry Methods and Explicit Teaching Strategies
Laurence B. Flick, Oregon State University

Exploring Science Teacher Metaphorical Thinking: A Case Study of a Secondary School Science Teacher
Cristine Schoneweg, Tom Dana, Pennsylvania State University

Elementary Teachers' Science Conceptions, Attitude Toward Teaching Science and Science Teaching Style
Carolyn L. Jeffries, University of California, Los Angeles

Elementary Teachers' Perceptions of Science Education, Classroom Practices and Professional Development
K. T. Willbite, Lewis-Clark State College

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4 Teacher Education

A Narrative of a First Year Science Teacher
Scott Robinson, Florida State University

An Analysis of the Responses of Science Student Teachers to Pupil Questions
Mary E. Durham, North Carolina State University

Reform in Elementary Science Education: A Critical Ethnography
Julie Thomas, University of Nebraska, Lincoln

Establishing an Action Research Agenda for Preservice and Inservice Elementary Teacher Collaboration on Self-empowerment in Science
Sharon Parsons, Karen Reynolds, San José State University

Preparing Elementary Science Teachers in Korea
Sung Hye Park, Tom Dana, Pennsylvania State University

Educating the Reflective Elementary Science Teachers in Taiwan
Tung-Hsing Hsiung, Chao-Ti Hsiung, National Taipei Teachers College, Taiwan

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5 Curriculum, Evaluation and Assessment

Performance Tasks and Performance Assessment of High School Students Studying Primary Prevention of Cardiovascular Diseases
Miriam Welicker, Reuven Lazarowitz, Technion – Israel Institute of Technology, Israel

A Comparison of the Computer Administered and Written Forms of Multiple Choice Testing
David B. Zandvliet, Malaspina University College; Pierce Farragher, University of Victoria

The Effect of the Constructivist Approach in Science on Attitudes of Grade 3 Students: A Case Study of One School's Approach
Judith Sheppard, Decker Elementary School

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6 Cultural, Social and Gender Issues

GEESE: Gender and Ethnic Equity in Science Education
Linda D. Bullock, University of Texas at Austin

Critical Examination of Ethnicity, Class, Gender, Culture and Learning: Preservice Secondary Science Teachers
Patrice McDaniel, Denise Crockett, Mary M. Atwater, University of Georgia

7 Educational Technology

A Conceptual Change Rationale for the Design of BioMap: An Interactive Hypermedia Environment to Promote Conceptual Understanding of Biological Evolution
Sharolyn J. Belzer, University of Michigan

Aspects and Considerations of the Automatic Speech Recognition of Spanish: Artificial Intelligence
Carlos A. Reyes-Garcia, Instituto Tecnológico de Apizaco, Mexico; Ramon A. Mata-Toledo, James Madison University

10 Others

The Use of the Learner Profile in Observing Middle School Teachers Implementing Inquiry: Teaching Methods
Nathan Carnes, Miami University (Ohio)

10:30AM — 12:00PM STRAND SESSION SUNDAY 23 APRIL

Initiatives in Curriculum and Evaluation (5 Curriculum, Evaluation and Assessment : Discussion Group)

Presider: *Tom Elliot, University of Georgia* — **California**

New Directions for Science Institutes: The Project-based Science Experience
John G. Freeman, Ronald W. Marx, University of Michigan

Natural Selection Conceptions Assessment: Development of the Two-tier Test
John Settlage, Jr, Cleveland State University; A. Louis Odom, University of Missouri

Teaching Invention and Design: An Exploratory Study
Jonathan A. Plucker, Michael Gorman, University of Virginia

Structuring Chemistry Laboratory Environments to Promote Critical Thinking and Learning
Jill L. Keller, Philip C. Keller, University of Arizona

A Science-Technology-Society (STS) Critical Issues Course for General Studies Natural Science Credit: The Evaluation of a Pilot Offering
James A. Rye, Peter A. Rubba, Leonard Waks, Pennsylvania State University

Conversations about Conversations about Science (2 Learning: Classroom Contexts and Learner Characteristics : Interactive Symposium)

Presider: *Emily H. van Zee, University of California at Berkeley* — **Oregon**
Discussant: *Doris Ash, University of California at Berkeley*
Participants:
Emily H. van Zee, Akiko Kurose, Barbara Schnabel, University of California; Marletta Iwasyk, Seattle Public Schools; Dorothy Simpson, Mercer Island High School; Judy Wild, Sacred Heart School

Using Metacognitive Tools to Facilitate Faculty Development (4 Teacher Education : Interactive Symposium)

Presider: *Carl F. Berger, University of Michigan* — **Nevada**
Discussant: *Patricia Kerr, Hobart and William Smith College*
Participants:
Katherine M. Edmondson, Joseph Novak, Cornell University; Brian Coppola, University of Michigan; James Wandersee, Louisiana State University; Carl F. Berger, University of Michigan

Research and Evaluation in Natural History Museums and Science Centers: Methodology, Findings, Applications (10 Others : Interactive Symposium)

Presider: *John J. Koran, Jr, University of Florida* — **Redwood**
Discussant: *Mary Ann Barnes, University of North Florida*
Participants:
John J. Koran, Mary Lou Koran, University of Florida; Lynn D. Dierking, Science Learning Inc; Lehman Barnes, Jacksonville Museum of Science and History

Facilitating Teacher Change (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *Theo Wubbels, University of Utrecht* — **Monterey**

Changing Preservice Teachers' Perceptions of Scientific Inquiry
Marian L. Martinello, University of Texas at San Antonio

The Influence of an Outdoor School Experience on a Prospective Teacher Learning to Teach Science
William Hug, Lois M. Campbell, Pennsylvania State University

An Inservice Program Focusing on Collaboration to Facilitate Change in Elementary Science Teaching
Carol Briscoe, Joseph Peters, University of West Florida
Improved Science Content for Preservice Teachers: Modelling of Teaching Strategies Based on Current Science Education Reform Literature Part II — A Comparison of Three University Elementary Science Programs
Kathie M. Black, University of Victoria, Australia

Contemporary Assessment Approaches (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)
Presider: *Ken Gattis, North Carolina State University* — **Suite 2625**
Two Alternative Approaches to Performance Assessment
Samuel L. Clay, Richard R. Studweeks, Brigham Young University
A Qualitative and Quantitative Comparison of the Impact of Portfolio Assessment Procedures versus Traditional Assessment in a College Physics Course
Timothy F. Slater, Pittsburgh State University; Sara L. Samson, Joseph M. Ryan, University of South Carolina
An Analysis of the Portrayal of Scientific Explanation in Elementary School Science Textbooks
R. Timothy Smith, Michigan State University
Empirical Analysis of Student Performance on the Tasks of Asking Questions, Identifying Variables and Formulating Hypotheses
Paul J. Germann, University of Missouri, Columbia; A. Louis Odom, University of Missouri, Kansas City

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Philsophical Reflections on Science Education (8 History, Philosophy and Epistemology : Paper Set Grouped by Committee)
Presider: *Uri Zoller, Haifa University-Oranim, Israel* — **Suite 2601**
A Tale of Two "Isms": Constructivism in Practice
Allan Feldman, University of Massachusetts
From the Summit of "Truth" to the "Slippery Slopes": Science Education's Descent through Positivist-Postmodernist Territory
Cathleen C. Loving, Texas A & M University
The Myth of Normal Science in the Shadow of Chaos
M. Jayne Fleener, University of Oklahoma
Of Maggots and Saints: The Central Role of Fallacious Thinking in Science Education
Dana L. Zeidler, University of Massachusetts , Lowell

Three Approaches to Teaching Optics: A Video-based Discussion (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Proposer)
Presider: *Marcia Linn, University of California, Berkeley* — **Portola**
Discussant: *Jim Minstrell, Mercer Island High School, WA*
An Emphasis on Perception: Teaching Image Formation Using a Mechanistic Model of Vision
Sue Allen, Barbara White, John Frederiksen, University of California
Intermediate States and Powerful Ideas: Learning about Image Formation
Fred Goldberg, Sharon Bendall, San Diego State University
Constructing New Ideas about Light and the Formation of Images
Douwe F. Dykstra, Jr , William Smith, Boise State University

Exploring Scientific Activity and Students' Conceptions as They Engage in It (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Proposer)
Presider: *Wolff-Michael Roth, Simon Fraser University* — **Gold Rush A**
Discussant: *Kathleen Roth, Michigan State University*
Scientific Activity and the Two Ways of Knowing
Joe Becker, Maria Varelas, University of Illinois-Chicago
Thinking About Simple Machines: Model-based Reasoning in Design Contexts
Leona Schauble, Richard Lehrer, University of Wisconsin-Madison
Dynamics of Scientific Design and Explanation in Middle School Collaborative Groups
Lori A. Kurth, Charles W. Anderson, Michigan State University; Annemarie Palincsar, University of Wisconsin-Madison
Discourse Analysis as a Window into the Classroom
Richard A. Duschl, Leslie Petasis, University of Pittsburgh
Doing Experiments: What Does It Mean For Children?
Maria Varelas, University of Illinois-Chicago

Expert Science Teaching: Novice Through Expert (3 Teaching : Paper Set Grouped by Proposer)
Presider: *Judith Burry-Stock, University of Alabama* — **Washington**
Discussants: *Senta Raizen, National Center for the Improvement of Science Education; Robert Yager, University of Iowa*
Expert Science Teaching: Expert Science Teaching Educational Evaluation Model (ESTEEM)
Judith A. Burry-Stock, University of Alabama
Expertise in Preservice Science Education: An Innovative Approach to Training Elementary Science Educators
Gail Shroyer, Emmett Wright, Kansas State University

Expertise in Preservice Science Teaching Across 10 National Sites: The Salish Project
Judy Vopava, University of Iowa
Expertise in Inservice Science Education: Restructuring Science Educators through SS & C/Chautauqua
Garry Varrella, Susan Blunck, University of Iowa

The ScienceWare Project: Supporting Modeling and Inquiry via Computational Media and Technology (7 Educational Technology : Paper Set Grouped by Proposer.)

Presider: *Liza Finkel, University of Michigan* — Gold Rush B
Discussant: *Vincent Lunetta, Pennsylvania State University*
ScienceWare: Rationale and Context
Elliot Soloway, Joseph Krajcik, Liza Finkel, University of Michigan
Impact of ScienceWare and Foundations on Students' Attitudes
Steve Stratford, Liza Finkel, University of Michigan
Learner Centered Software Design to Support Students Building Models
Shari Jackson, Steve Stratford, Joseph Krajcik, Elliot Soloway, University of Michigan
Interactive Media Literacy in the Foundations of Science Classroom
Jeff Spitulnik, University of Michigan

Factors Affecting Student Choice of Career in Science in Australia, Canada, China, England, Portugal and Japan (10 Others : Paper Set Grouped by Proposer. Sponsored by the International Committee)

Presider: *Brian Woolnough, Oxford University, England* — Crystal
The FASSIPES International Project: Factors Affecting Student Choice of Career in Science in Six Countries
Brian E. Woolnough, Oxford University, England
Factors Affecting Student Choice of Career in Science: Students from Urban and Rural Schools in Australia
Deidra J. Young, Barry J. Fraser, Carolyn Montgomery, Joanne Tims, Curtin University, Australia
Factors Affecting Student Choice of Career in Science: Gender Differences in Canadian Schools
Jim Gaskell, Gaalen Erickson, Zhen Wang, University of British Columbia
Factors Affecting Student Choice of Career in Science: Different Approaches to Teaching Science in Japanese Schools
Tae Ryu, Sophia University, Japan; Miyuki Tanaka, Chiyoko Yuki, Hiroyoshi Kinoshita, Seibugakuen High School, Japan; Kazubino Akao, Shimazurika Co., Japan

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"Improving Science Education: International Perspectives": A Book Sponsored by the International Academy of Education (10 Others : Paper Set Grouped by Proposer)

Presider: *Barry J. Fraser, Curtin University, Australia* — Emerald
Development and Scope of the Book
Barry J. Fraser, Curtin University, Australia
Instructional Strategies
Herbert J. Walberg, University of Illinois at Chicago; Avi Hofstein, Weizmann Institute of Science, Israel
International Comparisons of Participation, Achievement and Attitudes
John P. Keeves, Flinders University, Australia
Gender Issues
Lesley H. Parker, Léonie J. Rennie, Curtin University, Australia; Jan Harding, International Gender and Science Technology Association, England
Students' Conceptions
David F. Treagust, Curtin University, Australia; Reinders Duit, University of Kiel, Germany

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12:00PM — 1:00PM LUNCH SUNDAY 23 APRIL

12:30PM — 2:30PM **STRAND 7 SYMPOSIUM** **SUNDAY 23 APRIL**

Computer as Learning Partner: A Retrospective, Part I (7 Educational Technology : Interactive Symposium)

Presider: *Nancy B. Songer, University of Colorado* — Crystal
Participants:
Marcia Linn, Phil Bell, Helen C. Clark, Elizabeth Davis, Brian Foley, Christopher Hoadley, Sherry Hsi, Eileen Lewis, Jacquie Madhok, Laurence Mullenberg, Dawn Rickey, Judy Stern, Rick Weinland, University of California at Berkeley; Carl Berger, Joe Krajcik, University of Michigan; Nick Burbules, University of Illinois; Bat Sheva Eylon, Weizmann Institute of Science, Israel; Doug Kirkpatrick, Foothill School; John Layman, University of Maryland; Jim Minstrell, Mercer Island High School; Rafi Nachmias, Yael Friedler, Hebrew University of Jerusalem, Israel; Roy Pea, Northwestern University; Nancy B. Songer, University of Colorado; Bob Tinker, TERC

Note: This session will continue in the next Strand Session

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1:00PM — 2:30PM STRAND SESSION SUNDAY 23 APRIL

When Models and Analogies Go Wrong (1 Learning: Students' Conceptions & Conceptual Change : Interactive Symposium)

Presider: *David Treagust, Curtin University, Australia* — **Emerald**

Participants:

Shawn Glynn, University of Georgia; John Gilbert, University of Reading, England; David F. Treagust, Allan Harrison, Grady Venville, Sue Stocklmayer, Rod Thiele, Curtin University, Australia

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Preliminary Results and Design Issues for the Salish Project (4 Teacher Education : Interactive Symposium)

Presider: *Robert K. James, Texas A & M University* — **Gold Rush B**

Participants:

Robert K. James, Texas A & M University; Robert Yager, University of Iowa; Herbert Brunkhorst, California State University; Patricia Simmons, University of Georgia; Mark Twiest, Indiana University of Pennsylvania; James Gallagher, Michigan State University; Tina Marshall-Bradley, Norfolk State University; Sheryl McGlamery, University of Northern Colorado; Gerald Krockover, Purdue University; Barbara Spector, University of South Florida

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Computer Technology and Science Assessment: A Research and Development Perspective (5 Curriculum, Evaluation and Assessment : Interactive Symposium)

Presider and Discussant: *James Shymansky, University of Iowa* — **Suite 2601**

Participants:

David Kumar, Florida Atlantic University; Stanley Helgeson, Donna Berlin, Arthur White; James Altschuld, Ohio State University; Nancy Romance , Florida Atlantic University; Michael Vitale, East Carolina University

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Group Work (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)

Presider: *Ruth Zuzovsky, Tel Aviv University, Israel* — **Nevada**

A Closer Look at Conflicting Expectations Embedded in Group Work: Profiles of Two Students
Gail Richmond, Joanne Striley, Michigan State University

How Do Middle School Students Learn Science? An Analysis of Scientific Content and Social Processes in Cooperative Groups
Julie A. Bianchini, Stanford University

One Computer Per Small Group Versus One Computer Per Class: How Two Different Formats Affect the Quality and Quantity of Student-Student Interactions While Using a Computer Simulation
Craig A. Berg, University of Wisconsin; Joy Brandstrom, Nicollete High School; Joe Sutter, Horace Mann Middle School

Role Negotiation: Implications for Special Education High School Biology Students Working in Small Groups
Marcia K. Fetters, University of North Carolina

Teachers' Understanding of Classroom Environments (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *William Pankratius, University of Las Vegas* — **California**

How Do Prospective Science Teachers Learn from Teacher Education? The Influence of Their Entering Conceptions about Science and Teaching
Linda M. Anderson, Kathleen L. Peasley, Michigan State University

Elementary Science Teaching and the Culture of Schooling: Dilemmas Facing Preservice Teachers
Sherry Sullivan, Butler University

Evaluating Inservice Science Teacher Education Programs: A Case Study
Craig Bowen, University of Southern Mississippi

Group Processes in Science Laboratory Work
Clare Christensen, Campbell J. McRobbie, Queensland University of Technology, Australia

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Curriculum Issues in Context (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)

Presider: *Bill Boone, Indiana University* — **Suite 2625**

Using Learning Cycles to Teach High School Chemistry
Anton E. Lawson, James P. Birk, Andrew Mazzolini, Arizona State University

The Influence of an Interdisciplinary Program on Teachers' Attitudes and Understandings of Interrelationships between Energy, Environment and Public Policy
Brian L. Gerber, Center For Energy Education; Ann M. L. Cavallo, University of Oklahoma; Edmund A. Marek, John Chiodo, University of Oklahoma

For All Intents and Purposes: Probing the Levels of Intended Curriculum for a High School Chemistry Class
Jane O. Larson, University of Colorado

The Effect on Student Performance of Placing Physics Problems in Real-life Context
Léonie Rennie, Lesley Parker, Leonie Maley, Curtin University, Australia

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Multicultural Perspectives (6 Cultural, Social and Gender Issues : Paper Set Grouped by Committee)

Presider: *Ed Robeck, University of British Columbia* — **Oregon**

Differential Socialization in a Multicultural Setting Affects Academic Achievement
James R. Campbell, Michael Kyriacou Koutsoulis, Polis Chrisochous, St. John's University

Science Performance Assessment and Language Minority Students: Exploring the Interface
Jerome M. Shaw, Far West Laboratory, California
Multicultural Science Education for Diverse Student Populations
Dana Caseau, California State University at Fresno; Katherine Norman, University of Texas at Brownsville
Educating the Migrant Child with Different Levels of English Proficiency
Francisca Garcia de Kidder, Charles W. Anderson, Michigan State University

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Skills, Concepts and Interactive Learning (7 Educational Technology : Paper Set Grouped by Committee)
Presider: *David Jackson, University of Georgia* — **Portola**
Effect of a Microcomputer Based Lab on Graphing Interpretation Skill and Understanding of Motion
Michael T. Svec, Rockhurst College
Students Modeling Concepts and Conceptions
Michele W. Spitulnik, University of Michigan
Use of Telecommunications to Deliver University Science Content/Education Courses to High School Science Teachers: An Evaluation
Derrick R. Lavoie, University of Northern Iowa
Educational Aspects of Developing a Computer-based Multimedia Physics Instructional Package for Students with Limited Physics Backgrounds
Mario G. Zadnik, Robert D. Loss, David F. Treagust, Curtin University, Australia

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Constructivismo y Perspectivas Culturales (9 Spanish Sessions : Paper Set Grouped by Committee)
Presider: *Marta Pesa, Universidad Nacional de Tucuman* — **Washington**
Aspectos y Consideraciones del Reconocimiento Automatico del Habla Espanola
Carlos Alberto Reyes-García, Instituto Tecnológico de Apizaco, Mexico, Ramón Alberto Mata-Toledo, James Madison University
Constructivismo y Condicionamiento en los Procesos de Ensenanza y Aprendizaje de las Ciencias
Alfonso Suárez-Gómez, Pontificia Universidad Javeriana, Colombia
Supuestos Pedagogicos en el uso Del Lenguaje Logo
Fernando Molina, V. Vargas, F. Daza, Pontificia Universidad Javeriana
Ensenanza de las Ciencias: Aproximacion Sociocultural
Lilia Reyes-Herrera, Florida State University; Gloria Jiménez, Universidad Pedagógica Nacional, Colombia

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Teachers and Teaching (10 Others : Paper Set Grouped by Committee)
Presider: *John Matson, San Jose State University* — **Monterey**
Certification Standards and Science Teacher Supply
Sharon P. Hudson, Morehead State University
Visionquest: Teachers' Perceptions of Reform in Science Education
Safian Said, Dana L. Zeidler, University of Massachusetts, Lowell
Developing a Teacher Education Activity while Researching Students' Knowledge
Aletta Zietsman, University of the Witwatersrand, South Africa
Teachers and Research: Partnership for Reform
Judith Johnson, University of Central Florida

Toward an Understanding of Science Teacher Development: A Focus on Interpretive Case Study Research
(3 Teaching : Paper Set Grouped by Proposer)
Presider: *Julie Gess-Newsome, University of Utah* — **Gold Rush A**
Discussant: *Ken Tobin, Florida State University*
The Social Construction of Textbook-centered Science: A Cross-case Analysis of Second-career and First-career Beginning Teachers
Richard R. Powell, Texas Tech University
The Construction of Beliefs about Science Teaching and Learning by Bilingual Native American Preservice Teachers
Elizabeth Charron, Montana State University
A Look at Cases in the Development of Reflective Practice: A Case Study of Prospective Teachers of Elementary School Science
Tom Dana, Nancy F. Dana, Pennsylvania State University
Development of Content Knowledge and Pedagogical Content Knowledge of Prospective Elementary Teachers
Anita Roychoudhury, Miami University (Ohio); Deborah Tippins, University of Georgia

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Performance Assessment in Science: Examining the Roles of Teachers and Students (5 Curriculum, Evaluation and Assessment : Paper Sets Grouped by Proposer)
Presider: *Jill Keller, University of Arizona* — **Redwood**
Beginning Science Teachers and Performance Assessment in Connecticut
Michal Lomask, Joan Boykoff Baron, Connecticut State Department of Education
Teachers' Assessments and Pupils' Self-assessment in Great Britain
Paul Black, King's College, London, England

Teachers' Involvement in Balanced Assessment in Israel
Pinchas Tamir, Hebrew University of Jerusalem, Israel
Alternative Assessment in Science in New York State
Rodney L. Doran, State University of New York at Buffalo
Reliability and Validity of Performance Assessments
Maria A. Ruiz-Primo, Richard J. Shavelson, University of California at Santa Barbara

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2:45PM — 3:45PM STRAND SESSION SUNDAY 23 APRIL

The Use of Metacognitive Tools to Facilitate Knowledge Production (5 Curriculum, Evaluation and Assessment : Discussion Group)
Presider: *Michael Wavering, University of Arkansas* **Monterey**
Participants:
Joseph D. Novak, Richard Iuli, Cornell University

Computer as Learning Partner: A Retrospective, Part II (7 Educational Technology : Interactive Symposium)
Presider: *Eileen Lewis, University of California at Berkeley* **Crystal**
Participants:
Marcia Linn, Phil Bell, Helen C. Clark, Elizabeth Davis, Brian Foley, Christopher Hoadley, Sherry Hsi, Eileen Lewis, Jacquie Madhok, Lawrence Muilenberg, Dawn Richey, Judy Stern, Rick Weinland, University of California at Berkeley; Carl Berger, Joe Krajcik, University of Michigan; Nick Burbules, University of Illinois; Bat Sheva Eylon, Weizmann Institute of Science, Israel; Doug Kirkpatrick, Foothill School; John Layman, University of Maryland; Jim Minstrell, Mercer Island High School, Rafi Nachmias, Yael Friedler, Hebrew University of Jerusalem, Israel; Roy Pea, Northwestern; Nancy B. Songer, University of Colorado; Bob Tinker, TERC
Note: This session is continued from the previous Strand Session

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Minorities and the Teaching and Learning of Science (6 Cultural, Social and Gender Issues : Invited Session)
Presider: *Kenneth Tobin, Florida State University* **Emerald**
Speaker: *John Ogbu, University of California at Berkeley*

The Thinker Tools II Project: A Computer-based Curriculum for Scientific Inquiry and Modeling (7 Educational Technology : Invited Session)
Presider: *Gerald Abegg, Boston University* **Portola**
Presenters: *Barbara Y. White, University of California ; John R. Frederiksen, Educational Testing Service*

High School Students' Understanding and Problem Solving (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)
Presider: *Mark Cracolice, University of Oklahoma* **Oregon**
Teaching Science in Inclusive Classrooms Through STS Investigations
Katherine Norman, University of Texas; Dana Caseau, Jennifer Cooper, Karen Valdivisco, Lisa Outlow, Greg Conner, California State University at Fresno
High School Students' Views about the Meaning of Technology
Alan Griffiths, Nancy Parsons-Heath, Memorial University of Newfoundland
Everyday Thoughts about Nature: An Interpretive Study of Sixteen Ninth Graders' Conceptualizations of Nature
William W. Cobern, Arizona State University West; Adrienne Gibson, Scott Underwood, Cactus Shadows High School

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Understanding Analogies (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)
Presider: *Donna Dorough, Pennsylvania State University* **Gold Rush B**
The Challenge and Potential of Self-generated Analogies with Elementary School Science Students
E. David Wong, Michigan State University
Analogy Use in Experts and in Instruction
John Clement, Scientific Reasoning Research Institute
Analogy Maps: Determinants of Conceptual Understandings?
Rodney B. Thiele, Curtin University, Australia

High School Students' Understanding and Problem Solving (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)
Presider: *Olugbemiro Jegede, University of Southern Queensland, Australia* **Nevada**
Success in High School Chemistry: What Does It Mean and What Does It Take to be a Good Student?
Charles Rop, Michigan State University

The Effects of Verbal Explicitness on College Chemistry Students' Mental Model Building
Vickie M. Williamson, Kenneth C. Williamson, Illinois State University
A Study of the Relationships Between Student Learning Style and Performance in Introductory College Chemistry
Linda C. Grynkewich, Ronald Simpson, Darwin Smith, University of Georgia

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Teachers' Attitudes and Beliefs (3 Teaching : Paper Set Grouped by Committee)
Presider: *Betty Bitner, Southwest Missouri State University* — **Suite 2601**
Preservice Elementary Teachers' Rationales for Instructional Preferences Regarding the Teaching of Science in Elementary School
Sheila M. Jasalavich, Marist College, New York
Ideas about Science and Teaching from Teachers in 14 Countries: An Analysis of Data from Piloted Questionnaires of the Third International Mathematics and Science Study
Leland Cogan, Richard Houang, Michigan State University
Teaching Approaches in English Science Classes: Has the National Curriculum Really Changed Them?
Terry Hudson, Robin Smith, Sheffield Hallam University, England

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Teachers and Curriculum Initiatives (4 Teacher Education : Paper Set Grouped by Committee)
Presider: *Edmund Marek, University of Oklahoma* — **Washington**
The Missing Link: The Implemented Curriculum in Project 2061
Sharon J. Lynch, George Washington University
Teachers' Attitudes Toward Science Education Research: A Classroom Survey
Philip R. Pankiewicz, SUNY College ; Obed Norman, Washington State University
Through a Sideways Door: A Resource Model of Science Teacher Change
Gail Jones, Elizabeth M. Vesilind, University of North Carolina at Chapel Hill

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Teaching and Learning as Empowerment (4 Teacher Education : Paper Set Grouped by Committee)
Presider: *Murray Jensen, University of Minnesota* — **California**
Teaching and Learning as Empowerment: A Case Study from Elementary Science Teacher Education
Jenice French, Kansas State University; Thomas Koballa, Jr, University of Georgia
A Comparison of Program Coordinators' Leadership Models in Science and Mathematics and Lead Teachers' Implementation of those Models in the Schools: Is there a Match?
Catherine R. Nesbit, Josephine Wallace, University of North Carolina at Charlotte; Anne-Courtney Miller, University of North Carolina at Greensboro

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Aspectos de Bioquímica y Biologia (9 Spanish Sessions : Paper Set Grouped by Committee)
Presider: *Jesuina Pacca, Universidad de Sao Paulo, Brazil* — **Suite 2625**
La Ensenanza y el Aprendizaje de la Bioquimica Desde la Perspectiva de la Teoria General de Sistemas
Ernesto Pachón, Pontificia Universidad Javeriana, Colombia
Un Modelo Para la Ensenanza y el Aprendizaje de la Bioquimica Basado en la Formacion y Adquisicion de Conceptos
Luz B. Pardo, Ernesto Pachón, Pontificia Universidad Javeriana, Colombia
Las Nociones de lo Vivo y lo No Vivo en Ninos de Primero de Primaria
Norma Constanza Castaño, Pablo Antonio Bonilla, Julio Munevar, Aura Burgos, Universidad Pedagógica Nacional, Colombia

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Teacher Beliefs and Science Education Reform (3 Teaching : Paper Set Grouped by Proposer)
Presider: *Amy Palmeri, Indiana University* — **Redwood**
Relationships Between Teacher Beliefs and Science Education Reform
Charlene M. Czerniak, Andrew T. Lumpe, University of Toledo
The Determinants of Ohio Teachers' Intentions to Implement the State Science Model into Their Classroom Instruction
Jodi J. Haney, Bowling Green State University
Teachers' Beliefs and Their Intent to Implement Scientific Uncertainty in the Classroom
Andrew T. Lumpe, Charlene M. Czerniak, University of Toledo

Utilizing Front-end Evaluation and Research to Understand Museum Visitor Knowledge and Interest (10 Others : Paper Set Grouped by Proposer)
Presider: *Jon Pedersen, University of Arkansas* — **Gold Rush A**
Utilizing Interpretive Carts to Collect and Analyze Visitor Conversations in a Natural History Museum
Lynn D. Dierking, Dana Holland, Science Learning, Inc.
Assessment of the General Public's Life Science Conceptual Frameworks
John H. Falk, Science Learning, Inc.
Naive Knowledge and the Design of Science Museum Exhibits
Minda Borun, Franklin Institute Science Museum; Christine Massey, Swarthmore College; Tiiu Lutter, University of Pennsylvania

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4:00PM — 5:30PM STRAND SESSION SUNDAY 23 APRIL

The Teacher's Perspective (3 Teaching : Discussion Group)

Presider: *Paul Germann, University of Missouri, Columbia* — **Suite 2601**

Multicultural Science Education: Philosophical and Historical Questions of Ownership
Obed Norman, Washington State University

Preservice and Inservice Elementary Teachers' Classroom Experiences with Science/Mathematics Integration
Mark Guy, Mavis Kelley, University of North Dakota

Science as Content, Science as Context: Working in the Science Department
John Wallace, Helen Wildy, Curtin University, Australia

A Critical Perspective on Professional Development in Science Education: A Case Study
Tony Lorsbach, University of Alabama

Preservice and Inservice Teacher Education (4 Teacher Education : Discussion Group)

Presider: *Barbara Moon, Simon Fraser University* — **Redwood**

Model Perception Among Preservice and Inservice Chemistry Teachers
Nitza Barnea, Yehudit J. Dori, M. Finegold, Technion — Israel Institute of Technology, Israel

The Maryland Collaborative for Teacher Preparation Year One Report: Collaborating with Mathematics and Science College Professors to Construct Specialized Upper Elementary Middle School Teacher Preparation Programs
Randy McGinnis, Anna Graeber, University of Maryland, Gerry Rossi, Salisbury State College, Marcia Cushall, Frostburg State College, Geneive Knight, Coppin State College, Joan Langdon, Bowie State College, Tad Watanabe, Towson State University

An Exploration of the Interplay between Preservice Teachers' Existing Science Knowledge and Constructivist Instructional Strategies
Brenda J. Gustafson, Patricia M. Rowell, University of Alberta

Planning to Teach Elementary School Science Lessons: A Study of Preservice Teachers' Preparation and Action
Patricia M. Rowell, Sandra Guilbert, University of Alberta

Contributors to the Decision of Elementary Education Majors to Choose Science as an Academic Concentration
Jacquelyn J. Moore, Scott B. Watson, East Carolina University

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Transforming Curriculum: The Evolution of a Collaborative Campus Renewal Project (5 Curriculum, Evaluation and Assessment : Interactive Symposium)

Presider and Discussant: *Sheila Pirkle, Louisiana State University* — **Nevada**

Participants:
Sheila Pirkle, Louisiana State University; Frank Cartledge, Louisiana State University College of Basic Science; Kerry Davidson, Louisiana Board of Regents; Mary-Ellen Jacobs, James Wandersee, Louisiana State University; Exyie Ryder, Southern University

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Theory Revisited: Further Exploration of a Model of the Relationship between Gender and Science (6 Cultural, Social and Gender Issues : Interactive Symposium)

Presider: *Joanne Tims, Curtin University* — **Gold Rush B**

Participants:
Lesley H. Parker, Leonie Rennie, Curtin University; Jane Butler Kahle, Dana Riley, Miami University (Ohio)

Technological Support for the Professional Development of Science Teachers (7 Educational Technology : Interactive Symposium)

Presider: *Joseph S. Krajcik, University of Michigan* — **Gold Rush A**

Discussants: *Nancy Songer, University of Colorado; Norm Lederman, Oregon State University*

Participants:
Joseph S. Krajcik, Elliot Soloway, Ronald W. Marx, Phyllis Blumenfeld, Nathan Bos, Barbara Ladewski, University of Michigan

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Panel Review of "Science Teaching: The Role of History and Philosophy of Science" (8 History, Philosophy and Epistemology : Interactive Symposium)

Presider: Fred Finley, University of Minnesota — **Crystal**

Participants:
Michael R. Matthews, University of New South Wales, Australia; Norm Lederman, Oregon State University; Cathleen Loving, Texas A & M University; Denis Phillips, Stanford University

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Recent Trends in European Science Education Research (10 Others : Interactive Symposium. Sponsored by the International Committee)

Presider and Discussant: *Peter Heuson, University of Wisconsin, Madison* — **Emerald**

Participants:
Reinders Duit, University of Kiel, Germany; Rosalind Driver, University of Leeds, England; John Gilbert, University of Reading, England; Richard Duschl, University of Pittsburgh; Philip Adey, King's College London, England; Theo Wubbels, Onno de Jong, Fred Korthagen, Utrecht University, The Netherlands

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Modeling in Biology (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Presider: *Peter Rubba, Pennsylvania State University* — **Monterey**

The Relationship between High School Biology Students' Content Knowledge of Diffusion and Osmosis and their Confidence in their Content Knowledge
Louis Odom, University of Missouri, Kansas City; Lloyd H. Barrow, University of Missouri, Columbia

Representations of an Osmosis Problem
June T. Zuckerman, SUNY at New Paltz

Students' Mental Models of Meiosis and Genetics Topics
Ann M. L. Cavallo, Stacy Sheperson, University of Oklahoma

High School Students' Use and Revision of Models of Meiosis in Solving Inheritance Pattern Genetic Problems
Cynthia F. Wynne, University of Wisconsin-Madison

Problem Solving Techniques (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Presider: *Julie Cook, Ohio State University, Lima* — **Suite 2625**

Concept Mapping as a Tool for Problem Solving in Science
Peter Okebukola, Lagos State University, Nigeria; Olu Jegede, University of Southern Queensland, Australia; Rose Agholor, Curtin University, Australia

The Effect of Explicit Problem Solving Instruction on Students' Problem Solving Performance and Conceptual Understanding of Physics
Douglas Huffman, Pat Heller, University of Minnesota

Fostering Effective Prediction Problem Solving Through Cognitive Analysis and Guided Practice
Roy Hurst, University of Southern Mississippi

Assessing Student Problem Solving Success on Selected Topics in Introductory Chemistry
Diana Mason, University of Texas at Austin

Advances in Assessment (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)

Presider: *Eleanor Abrams, University of New Hampshire* — **Oregon**

After Three Years in a Middle School Reform Project: Are Students Scientists Yet? Involving Teachers in Designing Assessments to Align with Reform Goals
Helen Parke, East Carolina University; Wendy McColskey, SERVE; James Altschuld, Ohio State University; Rita O'Sullivan, University of North Carolina, Greensboro; Randy Yerrick, East Carolina University

Performance Assessment of Higher Order Thinking Skills in Elementary School Science: What Do We Measure?
Uwe Hameyer, Jurgen Baumert, University of Kiel, Germany; Robert H. Evans, Wake Forest University

Thinking and Reasoning on Statewide Science Assessments: Examples from Performance-based Assessments in California
Timothy J. Breen, Gail P. Baxter, University of Michigan; Robert Glaser, University of Pittsburgh

Equity Issues for Large-scale Performance Assessments: An Analysis of Gender and Race Differences
Scott F. Marion, Lorrie A. Shepard, University of Colorado

Interactive Learning Environments (7 Educational Technology : Paper Set Grouped by Committee)

Presider: *Derrick Lavoie, University of Northern Iowa* — **Portola**

Effectiveness of an Interactive Learning Environment to Teach Problem Solving Skills to Students at Risk of Academic Failure
Rebecca Denning, Ohio State University; Phillip J. Smith, Cognitive Systems Engineering Laboratory

A Computer-assisted Scientific Literacy Development Plan
Patrick Cronin, Leonie Rennie, Curtin University, Australia; Gary Williams, University of Western Australia, Australia

Image Processing in a Science Classroom: Students' Interpretations of Images
Jeffrey S. Friedman, University of California at Berkeley

Unexpected Consequences of Using Technology to Help Elementary School Students Understand about Sound and Music
Shirley Magnusson, Danielle Ford, Mark Templin, Annemarie S. Palincsar, University of Michigan

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The Rocky Mountain Teacher Education Collaborative (4 Teacher Education : Paper Set Grouped by Proposer)

Presider: *Fred Stein, Colorado State University* — **Washington**

Science Reforms in the Rocky Mountain Teacher Education Collaborative
Loretta Jones, Jay Hackett, University of Northern Colorado

Mathematics Reforms in the Rocky Mountain Teacher Education Collaborative
James Loats, Metropolitan State College of Denver

Diversity Reforms in the Rocky Mountain Teacher Education Collaborative
Marilyn Taylor, Metropolitan State College of Denver; Kathryn Cochran, University of Northern Colorado

Pedagogy Reforms in the Rocky Mountain Teacher Education Collaborative
Barbara Nelson, Nancy Hartley, Colorado State University

PACE: A Participant Constructed Evaluation Model and Its Application (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Proposer)

Presider: *David P. Butts, University of Georgia* — **California**

Discussant: *Mary Louise Bellamy, National Association of Biology Teachers*

An Evaluation Model with Participant Constructed Components
Thomas Koballa, Jr, David P. Butts, Joseph Riley, University of Georgia

Does a Summer Research Experience Make a Difference? An Application of the PACE Model to the ASCB Summer Research Fellows Program
David P. Butts, University of Georgia, Robert Bloodgood, University of Virginia

Does a Summer Industrial/Research Experience Make a Difference? An Application of the PACE Model to the GIF Program
JoAnna Fox, John R. Wiggins, Georgia Institute of Technology, David P. Butts, University of Georgia

Does a Summer Leadership Program Make a Difference? An Application of the PACE Model to the Georgia ST3 Leadership Program
Joseph Riley, University of Georgia

6:00PM — 9:30PM EVENING AT EXPLORATORIUM SUNDAY 23 APRIL

Exploring Informal Science Education: An Evening at the Exploratorium

Presiders: *Goéry Delacôte and Sally Duensing, San Francisco Exploratorium*

- Buses depart from the Holiday Inn at 6.00 pm and 6.30 pm.
- A welcome and orientation session led by the Director, Goéry Delacôte, will be held in the Theater at 6.30 pm and 7.00 pm.
- As the Exploratorium will be closed to the public, NARST members will have full access to exhibits on the museum floor, classrooms, theater, library and bookstore.
- A buffet dinner will be provided.
- Buses leave the Exploratorium commencing at 8.30 pm and finishing at 9.30 pm.

7:00PM — 8:30PM POSTERS AT EXPLORATORIUM

1 Learning: Students' Conceptions & Conceptual Change

The Process of Conceptual Change about Collisions
Lizete M. Orquiza de Carvalho, UNESP, Alberto Villani, University of São Paulo, Brazil

Effects of Instruction on Preservice Elementary Teachers' Conceptions of What Causes Night and Day and the Seasons
Ronald K. Atwood, Virginia A. Atwood, University of Kentucky

The Bernoulli Effect: Initial Study of Open and Closed Systems
Anthony J. Petrosino, Daniel L. Schwartz, Vanderbilt University

Fifth and Sixth Grade Students' Explanations of Global Warming and Ozone: Conceptions Formed Prior to Classroom Instruction
Donna K. Dorough, James A. Rye, Peter A. Rubba, Pennsylvania State University

Using Drawings to Investigate Children's Understanding of Concepts
Tina Jarvis, Leicester University, England, Leonie Rennie, Curtin University, Australia

Student Understanding of Selected Science Concepts Related to Water
Linda B. Hagelin, Karen Reynolds, San José State University

A Learning Process Study on Elementary Features of Chaos Theory
Michael Komorek, Reinders Duit, University of Kiel, Germany

Videos of Case Studies: Issues Involved in the Development of Images for Science Teacher Education
Sue Mattson, Harvard-Smithsonian Center

Do Teachers "Help" Students to Strengthen Preconcepts? Some Reflections about the Teaching of Image Formation by Converging Lenses
Marta Pesa, Leonor Colombo de Cudmani, Silvia Bravo, Universidad Nacional de Tucoman, Argentina

The Monochromatic Lightwave Model in Learning Physical Optics
Leonor Colombo de Cudmani, Marta Pesa, Julia Salinas, Universidad Nacional de Tucoman, Argentina

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2 Learning: Classroom Contexts and Learner Characteristics

Inquiring Moments: Capturing Preschoolers Doing Science
Shireen J. M. Desouza, Georgia Southwestern College

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3 Teaching

Determining and Comparing the Alternative Conceptions of the Concept of Force of Non-science Education Majors and Practicing Teachers Using the Interview-about-Instance Technique
Dennis W. Sunal, Linda Ewing, University of Alabama

The Genesis of the Mathematics Demonstration
Egberto Agard, Universidad de Panamá, Panamá

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4 Teacher Education

Bringing Summer Field-based Experiences Back Into K-12 Classrooms
Keith McElroy, University of Kentucky

Intervening in the Professional Development of Science Teachers: The Colorado Science Teaching Enhancement Project
James D. Ellis, Donald E. Maxwell, Biological Sciences Curriculum Study, Paul J. Kuerbis, The Colorado College

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5 Curriculum, Evaluation and Assessment

Project EARTHSTORM: Integrating Real-time Weather Data into the Science Classroom
Melanie A. Reap, Georgianna Saunders, Ann M. L. Cavallo, University of Oklahoma

The Development, Field Test and Validation of a Wetland Ecology Test
Jeff A. Thomas, Rosalina V. Hairston, University of Southern Mississippi

6 Cultural, Social and Gender Issues

Establishing a Mother/Daughter Science Club: A Case Study
Frances Tate Chandler, San José State University

The Teaching of Science: A Sociocultural Approximation
Lilia Reyes-Herrera, Florida State University

7 Educational Technology

Ohio's Classroom of the Future and its Effects on Students' Science Efficacy
Ron Browne, Georgia Southern University

Enabling Student Research of Environmental Problems Using a Geographic Information Systems Approach
Timothy P. Olsen, University of Wisconsin-Madison

10 Others

Exploring Students' Constructed Perceptions of Science Through Visiting Particular Exhibits at a Science Museum
Dana Riley, Jane Butler Kahle, Miami University (Ohio)

Interpreters' Perceptions about the Goals of the Science Museum in Taiwan
Chi-Chin Chin, National Museum of Natural Science, Taiwan

The Educational Impact of an Overnight Museum Experience
Susan E. Sunbury, Boston University

Perceptions of Visitors' Learning at an Interactive Science and Technology Centre
David Johnston, Léonie Rennie, Curtin University, Australia

"Did You Hear the Message?": Visitors' Use and Understanding of a Sound Exhibit at Interactive Science Centers
Terence P. McClafferty, Curtin University, Australia

Prototyping for the 21st Century
Joost J. Douma, IMPULS Science & Technology Center, The Netherlands

MONDAY April 24

Program Overview

Session	Room	Time
Committee Meetings		7.00 am – 8.30 am
STRAND SESSION		8.30 am – 10.00 am
STRAND SESSION		10.30 am – 12.00 pm
Awards Luncheon	EMERALD	12.00 pm – 2.30 pm
STRAND SESSION		2.30 pm – 3.30 pm
STRAND SESSION		4.00 pm – 5.00 pm
NARST Outstanding Paper Presentation	GOLD RUSH B	4.00 pm – 5.00 pm
NARST Business Meeting	GOLD RUSH B	5.00 pm – 6.00 pm
Next Generation of Researchers' Dinner Chats	CALIFORNIA	6.00 pm – 8.00 pm
Executive Board Meeting and Dinner	MONTEREY	6.30 pm – 8.00 pm
Science Theater *Archimedes: To Sink or Not to Sink* Michael Gore (Questacon, Australia's National Science and Technology Centre)	CRYSTAL	8.00 pm – 9.30 pm

MONDAY April 24

Strand Highlights

Sponsor	Session	Time & Room
STRAND 10	*National Science Foundation's Research in Teaching and Learning Program: Where We Are Going and How to Get There* Barbara E. Lovitts, National Science Foundation	8.30 am – 10.00 am WASHINGTON
INTERNATIONAL COMMITTEE	*Teaching with Students' Ideas in Mind* Peter W. Hewson, Beverley Bell, Nella Grimellini-Tomasini, Gertrude Hennessey, Aletta Zietsman, Audrey Champagne	10.30 am – 12.00 pm REDWOOD
INTERNATIONAL COMMITTEE	*Dimensions of Inservice Teacher Development* Philip Adey, Justin Dillon, Martin Monk, Robert Fairbrother, Christine Harrison, Siew-Bee Lim, Larry Enochs	10.30 am – 12.00 pm GOLD RUSH B
STRAND 10	*Handbook of Research in Science Teaching and Learning: A Review of the Past and a Look to the Future* Dorothy Gabel, Ronald Anderson, Anton Lawson, Carl Berger, Jane Butler Kahle	10.30 am – 12.00 pm GOLD RUSH A
STRAND 10	*Is Learning From Science Center Exhibits Fake Learning?* Goéry Delacôte (San Francisco Exploratorium)	2.30 pm – 3.30 pm GOLD RUSH A
STRAND 5	*Comprehending the Current Guidelines for Science Education Reform* Paul DeHart Hurd (Stanford University)	4.00 pm – 5.00 pm EMERALD

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7:00AM — 8:30AM COMMITTEE MEETINGS MONDAY 24 APRIL

Policy Advisory Committee — Gold Rush A
Presider: *Kenneth Tobin, Florida State University*

Research Committee — Gold Rush B
Presider: *Audrey Champagne, SUNY at Albany*

Equity Committee — Redwood
Presiders: *Dale Baker, Arizona State University and Kate Scantlebury, University of Delaware*

Graduate Students and New Researchers Committee — Oregon
Presiders: *William G. Holliday, University of Maryland, Rebecca J. Pollard, Texas A&M University*

Small College Networking Committee — California
Presiders: *Katherine Norman, University of Texas, Brownsville, B. Patricia Patterson, University of Texas*

Liaison with Scientific Societies Committee — Nevada
Presiders: *Craig W. Bowen, University of Southern Mississippi, Diane Ebert-May, Northern Arizona University*

NARST Presentations at Other Professional Meetings Committee — Washington
Presider: *Kenneth Tobin, Florida State University*

8:30AM — 10:00AM STRAND SESSION MONDAY 24 APRIL

Laboratory Instruction (4 Teacher Education : Discussion Group)
Presider: *Mary Bird Dickinson, University of Maine* — Suite 2601

A Staff Development Model: Hands-on and Minds-on Museum Based Science Instruction
John R. Wiggins, Georgia Institute of Technology, B. Kim Nichols, University of Georgia

A Description and Evaluation of Two Instructional Strategies used with a Diffusion and Osmosis Computer Simulation
Murray Jensen, General College University of Minnesota

Longitudinal Patterns of Beginning Science Teachers' Stages of Concern Laboratory Usage
John R. Sode, North Dakota State University

The Effect of Inquiry Instruction on Undergraduate Biology Students' Perceptions of Their Science Laboratory Learning Environment
Fletcher Brown, University of Montana

Teaching and Learning Science in Challenging Contexts (3 Teaching : Interactive Symposium)
Presider: *Carrie Gee, Indiana University* — Gold Rush A
Kenneth Tobin, Florida State University, Henrietta Hoffman, Cannington Senior High School, Australia, John Wallace, David F. Treagust, Dorit Maor, Barry J. Fraser, Curtin University, Australia

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Gender and Science: Recasting the Long Shadow (6 Cultural, Social and Gender Issues : Interactive Symposium)
Presider and Discussant: *Kate Scantlebury, University of Delaware* — Emerald
Participants:
Leonie Rennie, Lesley Parker, Curtin University, Australia, Jan Harding, International Gender and Science Technology Association, England, Doris Jorde, University of Oslo, Norway, Jane Butler Kahle, Miami University (Ohio), Thomas Koballa, Jr, University of Georgia, Tina Jarvis, University of Leicester, England

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Building Dialogic Teaching and Research Communities in Science Education (8 History, Philosophy and Epistemology : Interactive Symposium)
Presider: *Elizabeth B. Moje, University of Utah* — Crystal
Discussant: *Mark J. Volkmann, Purdue University*
Participants:
Elizabeth B. Moje, University of Utah, William C. Kyle, Jr, Terry A. Scott, Mark J. Volkmann, Purdue University

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National Science Foundation's Research in Teaching and Learning Program: Where We are Going and How to Get There? (10 Others : Invited Session)
Presider: *Roger Olstad, University of Washington* — Washington
Speaker: *Barbara E. Lovitts, National Science Foundation*

Elementary Students' Understanding of Natural Phenomena (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)
Presider: *Stanley Helgeson, Ohio State University* — Monterey

Young Chinese Children's Conceptions of Life
Mei-Fun Wang Dai, Taipei Municipal Teachers College, Taiwan

Elementary Students' Conceptions in Ecology
Shu-Mey Yu, National Taichung Teachers College, Taiwan
Elementary School Children's Theories of Matter
Mary B. Nakhleh, Ala Samarapungavan, Purdue University
Children's Tacit and Explicit Understandings of Dinosaurs
Roberta H. Barba, San José State University

Learning Through Practical Experience (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Presider: *Sue Allen, University of California at Berkeley* — **Nevada**

Effects of Constructivist and Computer-facilitated Strategies on Achievement in Heterogeneous Secondary Biology
Maryellen Duffy, University of Massachusetts; Bill Barowy, Bolt, Berank and Newman
The Development of Science Investigation Skills through Elementary, Secondary and Tertiary Science Education
Mark W. Hackling, Patrick J. Garnett, Edith Cowan University, Australia
Students' Reflections on MBL Instruction: Interests, Frustrations and the Role of Gender
Gregory Kelly, University of California at Santa Barbara
Open Experimenting — A New Approach to Teaching and Learning Science
Peter Reinhold, University of Kiel, Germany

Writing for Understanding (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)

Presider: *Christine Cunningham, Cornell University* — **Suite 2625**

Writing in Junior Chemistry Classes: An Instrument of Learning Science Meaningfully?
Martina Nieswandt, University of Kiel, Germany
Taking a Critical Stance Toward Science Text: High School Science Students' Interpretations of Popular Reports of Science
Linda M. Phillips, Stephen P. Norris, Memorial University of Newfoundland
Initiating Authentic Investigation in an Urban Middle School: Indicators of Success in Scientific Reasoning and Writing
Carolyn W. Keys, Tarriatine Simmons, Georgia State University
Learning Logs: A Tool for Supporting Communities of Scientific Sense-makers
Richard H. Audet, Boston University; Paul Hickman, Belmont High School; Gerald L. Abegg, Boston University

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Teachers' Beliefs and Understandings (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *Ivo Lindauer, University of Northern Colorado* — **Redwood**

A Survey of Scientific Understandings: Comparison between Teachers and College Students
Michael H. Klapper, Ohio State University; Shirley DeLucia, Capital University; Jeffrey Trent, Ohio State University
Interpretive Analysis of Secondary Teachers' Use or Non-use of Inservice-provided Curriculum Innovations
Emmett Wright, Kansas State University; Luke Shokere, Donnelly College
The Role of Proverbs in the Construction of Knowledge about Science Teaching and Learning
Deborah Tippins, William Veal, Katherine Wieseman, University of Georgia

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Curriculum and the Learning Environment (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)

Presider: *Roy Hurst, University of Southern Mississippi* — **Gold Rush B**

How to Make Chemistry More Relevant to the Student
Miri Kesner, Avi Hofstein, Ruth Ben-Zvi, Weizmann Institute of Science, Israel
The Interactive Rouge River Water Quality Monitoring Program: An Evaluation of an Environmental Education Program
Valerie L. Talsma, University of Michigan
Many Visions, Many Aims: Curriculum and the Creation of Science Educational Opportunity
William H. Schmidt, Charles Rop, Michigan State University; Edward Britton, National Center for Improving Science Education
The School Learning Environment: Place for Teacher Learning or a Busy Workplace
Campbell J. McRobbie, Queensland University of Technology, Australia; Kenneth Tobin, Florida State University

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Images, Explanations and Attitudes (10 Others : Paper Set Grouped by Committee)

Presider: *Janette Griffin, Sydney University of Technology, Australia* — **California**

Elementary and Middle School Students' Image of Science and Scientists Related to Current Science Textbooks
Bor-Wei Lu, Teachers' Inservice Training Center of Taipei Municipality, Taiwan; Hsiao-Ching She, National Taiwan Normal University, Taiwan
The Scientific Attitude Inventory (SAI II): A Revision
Richard W. Moore, R. Leigh Hill Foy, Miami University
How Research Physicists and High School Physics Teachers Deal with the Scientific Explanation of a Physical Phenomenon
Judith R. Edgington, James P. Barufaldi, University of Texas
Lebanese Middle School Students' Definitions of Science and Perceptions of its Purpose and Usage
Saouma Boujaoude, Fouad Abd El Khalick, American University of Beirut

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Future Directions in Computer Learning (7 Educational Technology : Paper Set Grouped by Proposer)

Presider: *Marcia C. Linn, University of California at Berkeley* — **Portola**

Discussant: *Joseph Krajcik, University of Michigan*

Using a Knowledge Integration Approach to Teach the Physics of Sound
Brian Foley, University of California at Berkeley

Longitudinal Assessment of Conceptual Understanding and Its Relationship To Epistemological Views
Eileen Lewis, University of California at Berkeley

Students' Explanations and Integrated Understanding
Elizabeth A. Davis, University of California at Berkeley

Electronic Discourse and the Integrated Learning of Science
Philip Bell, Lydia Tien, University of California at Berkeley

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Language, Conceptualization and Learning in Physics, Biology and Water Science (1 Learning: Students' Conceptions & Conceptual Change: Paper Set Grouped by Proposer)

Presider: *Michael Kamen, Auburn University* — **Oregon**

The Development of Children's Discourse During a Unit on Buoyancy
Jeff Bloom, Acadia University

Integrating Science and Literacy: An All-School Focus On Oral Discourse
Mark J. Hallenbeck, Edward L. Smith, Michigan State University

Modeling Instruction in Physics
David Hestenes, Ibrahim A. Halloun, Arizona State University

An Emergent Typology of Biology Relations Used in AAAS Benchmarks
James A. Wandersee, Louisiana State University; Kathleen Fisher, San Diego State University

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10:30AM — 12:00PM STRAND SESSION MONDAY 24 APRIL

Teaching with Students' Ideas in Mind (1 Learning: Students' Conceptions & Conceptual Change : Interactive Symposium. Sponsored by International Committee)

Presider: *Peter W. Hewson, University of Wisconsin, Madison* — **Redwood**

Discussant: *Audrey Champagne, State University of New York at Albany*

Participants:
Peter W. Hewson, University of Wisconsin, Madison, Beverley Bell, University of Waikato, New Zealand; Nella Grimellini-Tomasini, University of Bologna, Italy, Gertrude Hennessey, St Ann's School, Stoughton, WI; Aletta Zietsman, University of Witwatersrand, South Africa

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Integrated Learning: Can It, Should It, Be Done? (5 Curriculum, Evaluation and Assessment : Interactive Symposium)

Presider: *Robert L. Fisher, Illinois State University* — **Suite 2625**

Participants:
Robert L. Fisher, Vickie M. Williamson, Illinois State University; John E. Penick, University of Iowa, Susan L. Westbrook, North Carolina State University; Emmett L. Wright, Kansas State University

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Handbook of Research in Science Teaching and Learning: A Review of the Past and a Look to the Future (10 Others : Interactive Symposium)

Presider: *Dorothy L. Gabel, Indiana University* — **Gold Rush A**

Participants:
Dorothy L. Gabel, Indiana University, Ronald D. Anderson, University of Colorado; Anton E. Lawson, Arizona State University; Carl F. Berger, University of Michigan; Jane Butler Kahle, Miami University (Ohio)

High School Learning Environments (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)

Presider: *Linda Phillips, Memorial University of Newfoundland* — **Nevada**

Using New Discourse Patterns to Support Learning in Science Class: The Case of Derek
Kathleen L. Peasley, Michigan State University

Students Perceived and Preferred Socio-cultural Classroom Climate in a Non-Western Environment
Olugbemiro Jegede, University of Southern Queensland, Australia; Rose Agbolor, Curtin University, Australia; Peter Okebukola, Lagos State University, Nigeria

How to Gain an Insight into Special Aspects of Chemistry Instruction
Claus Bolte, University of Kiel, Germany

Gender Differences in Biology Students' Perceptions of Actual and Preferred Learning Environments
David G. Henderson, Launceston College, Australia; Darrell L. Fisher, Barry J. Fraser, Curtin University, Australia

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Teaching: Four Interpretive Case Studies (3 Teaching : Paper Set Grouped by Committee)

Presider: *Gary Hepburn, University of British Columbia* — **Suite 2601**

Examining the Content Knowledge, Pedagogical Knowledge and Pedagogical Content Knowledge of Preservice Elementary Science Teachers
Carrie J. Gee, Indiana University; Michael Svec, Rockhurst College; J. Leonardo Sanchez, Dorothy Gabel, Indiana University

The Consistency between Second Grade Teachers' Attitudes and Beliefs toward Teaching Science and their Science Teaching Practice
Amy B. Palmeri, Indiana University

A Case Study of the Theoretical and Practical Knowledge Constructed by Two Teachers while Team-teaching an Engineering Unit
Wolff-Michael Roth, Simon Fraser University

Bridging the Gap between the Beliefs and Practices of College Biology Teachers and the Science-related Needs of Prospective Elementary Teachers
Penny Gilmer, Florida State University; Hedy Moscovici, Western Washington State University; Sue Mattson, Harvard-Smithsonian Center for Astrophysics; Kenneth Tobin, Florida State University

Teachers and Learning (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *Keith Lucas, Queensland University of Technology, Australia* — **Washington**

The Development and Application of a Diagnostic Test to Assess Teachers' Understanding of the Learning Cycle
Louis Odom, University of Missouri-Kansas City; John Settlage, Jr, Cleveland State University

Reforming Science Teaching: A Case Study of Changes
Anita Roychoudhury, Jane Butler Kahle, Miami University (Ohio)

Breaking the Cycle: Preparing Elementary Teachers to Teach Science
Judith Mulholland, Australian Catholic University, Australia; John Wallace, Curtin University, Australia

Autonomy: A Constructivist Learning Environment
Chao-Ti Hsiung, National Taipei Teachers College, Taiwan

Gender and Equity: A World Perspective (6 Cultural, Social and Gender Issues : Paper Set Grouped by Committee)

Presider: *Katherine Norman, University of Texas at Brownsville* — **Oregon**

"Voices from the Bridge": Kickapoo Indian Students and Science Education: A World View Comparison
Nancy Allen, University of Texas at Austin

The Gender Equity in Students' Image of Science and Scientists
Hsiao-Ching She, National Taiwan Normal University, Taiwan

Schooling Experiences of Black South African Students: A Case Study
Kwan-Min Lee, University of the Witwatersrand, South Africa

Reflexiones Multiples (9 Spanish Sessions : Paper Set Grouped by Committee)

Presider: *Marco A. Moreira, Instituto de Fisica UFRGS, Brazil* — **Monterey**

Maestros Actualizando Otros Maestros: Estudio de Caso
Jesuina L. Pacca, Alberto Villani, M. Cristina Mariani, Instituto de Fisica, UFRGS, Brazil

Desarrollo de Destrezas de Pensamiento Critico en Estudiantes del Curso de Introduccion a las Ciencias Naturales 100b
Lydia de Isaacs, Matilde Samudio, Universidad de Panama, Panama

Metodologias Utilizadas en la Ensenanza de La Fisica por los Profesores Panamenos de Varias Escuelas Pilotos vs Metodologias Propuestas por Diferentes Proyectos Internacionales
Matilde de Samudio, Sergio Guerra, Etelvina Medina, Universidad de Panama, Panama

Nociones de los Ninos de Pre-escolar Acerca de las Plantas
Norma Constanza Castaño, Nancy Espitia, Magda Miranda, Claudia Guerrero, Universidad Pedagogica Nacional, Colombia

Theoretical Frameworks: Problems and Strategies (10 Others : Paper Set Grouped by Committee)

Presider: *Bill Kermis, Southwestern Oklahoma State University* — **Portola**

Cognitive and Psychological Factors Affecting LVN Students' Success at Solving Medication Dosage Calculation Problems
William A. Allen, University of Texas at Austin; Frank E. Crawley, East Carolina University

The Crisis of Representation: Concept Mapping, Written Explanations and Students' Conceptual Frameworks in Evolution
Sherry S. Demastes, University of Utah; Ronald Good, Patsye Peebles, Louisiana State University

Problem Solving Strategies in a Problem-rich Environment
Ching-Kuch Chang, National Changhua University, Taiwan

A Synopsis of Methodology: Student Worldviews
Adrienne Gibson, Scott Underwood, Cactus Shadows High School; William Cobern, Arizona State University West

Multidimensional, Research-Based Approach to STES/HOCS: Oriented Teaching and Curriculum Development
(1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Proposer)

Presider: *Aviva Lubezky, Haifa University-Oranim, Israel* — **California**

Discussant: *Shoshana Keiny, Haifa University-Oranim, Israel*

In-Service Training for Leadership: Incorporating Environmental Aspects into Chemistry Teaching
Yehudit J. Dori, Haifa University-Oranim, Israel

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STES Curriculum Development as a Process of Conceptual Change
Shoshana Keiny, Haifa University-Oranim, Israel
Students' Environmental Awareness and Their Understanding of Chemistry Related STES Issues
Avica Lubezky, Uri Zoller, Yehudit J. Dori, Haifa University-Oranim, Israel
Algorithmic and Logs vs. HOCS Chemistry Examination Questions
Uri Zoller, Avica Lubesky, Yehudit J. Dori, Haifa University-Oranim, Israel

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Dimensions of Inservice Teacher Development (4 Teacher Education : Paper Set Grouped by Proposer. Sponsored by the International Committee)
Presider: *Gail Shroyer, Kansas State University* — **Gold Rush B**
Discussant: *Larry Enochs, University of Wisconsin, Milwaukee*
The Effects of a Staff Development Program: The Relationship Between the Level of Use of Innovative Science Curriculum Activities and Student Achievement
Phillip Adey, King's College London, England
Fourth Down and Fifty: The Role and Responsibilities of UK Consultants in an Indonesian Inservice Education Project
Justin Dillon, Martin Monk, King's College London, England
Negotiated Intervention: Partnership in Inservice Education
Robert Fairbrother, King's College London, England
Developing an Inset Culture in Nigerian Colleges of Education
Christine Harrison, King's College London, England
Changes in Attitudes Towards Professional Upgrading of Primary Science Teachers in Brunei Darussalam Following an Eight Week Inset Program
Siew-Bee Lim, University of Brunei Darussalam; Phillip Adey, King's College London, England

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12:00PM — 2:30PM AWARDS LUNCHEON MONDAY 24 APRIL

Emerald

2:30PM — 3:30PM STRAND SESSION MONDAY 24 APRIL

Evaluation of a National Science Reform Project: Effects of Context on Implementation Strategies, Outcomes and the Reform Process (4 Teacher Education : Interactive Symposium)
Presider: *John E. Penick, University of Iowa* — **Gold Rush B**
Participants:
Linda W. Crow, Baylor College of Medicine; Ronald J. Bonnstetter, University of Nebraska; Charles E. Coble, East Carolina University; Thomas Sachse, California Department of Education; Robert Yager, University of Iowa

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Representing a Gender Equity Project: Pedagogical Approaches and Methodological Concerns (6 Cultural, Social and Gender Issues : Interactive Symposium)
Presider: *Ed Robeck, University of British Columbia* — **Suite 2625**
Participants:
Ed Robeck, Jim Gaskell, Gary Hepburn, University of British Columbia; Gilda Segal, University of Technology, Sydney, Australia

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Is Learning from Science Center Exhibits Fake Learning? (10 Others : Invited Session)
Presider: *Léonie Rennie, Curtin University, Australia* — **Gold Rush A**
Speaker: *Goéry Delacôte, San Francisco Exploratorium*

Theoretical Issues in Thinking and Understanding (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)
Presider: *Gail Richmond, Michigan State University* — **Oregon**
Theories in Pieces? The Nature of Students' Conceptions and Current Issues in Science Education
David Brown, University of Illinois at Urbana-Champaign
Conceptual Change Learning: Some Theoretical and Pedagogical Issues
Michael Beeth, Ohio State University
A Model of Educational Reconstruction
Ulrich Kattmann, University of Oldenburg, Germany; Reinders Duit, University of Kiel, Germany

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Theories and Processes of Conceptual Change (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Presider: *Bruce Waldrip, Curtin University, Australia* — **Nevada**

What We Don't Understand about Teaching for Understanding
William Louden, Edith Cowan University, Australia; John Wallace, Curtin University, Australia

Educating in a Biology Classroom: A Coherent Approach to Teaching, Curriculum, Learning and Governance
Roselyn Brown Hammond, Morgan State University

Conceptual Organization of College Biology Students
Laura N. Rogers, University of North Carolina, Wilmington; Susan L. Westbrook, North Carolina State University

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Aspects of Teaching Science (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)

Presider: *Sally Brown, University of Stirling, Scotland* — **Washington**

Science Teaching Self-Efficacy of Preservice Elementary Teachers as Influenced by Heterogeneous Grouping
Lawrence C. Scharmann, Colleen Hampton, Kansas State University

Fit and Misfit of Loci of Commitment and Their Impact on the Learning of Science in a College Biology Course for Prospective Elementary Teachers
Hedy Moscovici, Western Washington University

What is Being Understood When Good Science Teachers Teach for Understanding?
Helen Wildy, John Wallace, Curtin University, Australia

Construction of Knowledge and Understanding (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)

Presider: *Martina Niesyandt, University of Kiel, Germany* — **Redwood**

A Constructivist Perspective on Monitoring Classroom Learning Environments under Transformation
Peter C. Taylor, Barry Fraser, Vaille Dawson, Curtin University, Australia

Scientific Reasoning as Appropriate and Adaptive to the Surrounding Context
Evelyn Oka, E. David Wong, Michigan State University

The Construction of Knowledge-in-action by Students and Teacher in an Enactive Science Classroom
Heidi Kass, A. Leo MacDonald, University of Alberta

The Teacher's Narrative (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *Randy McGinnis, University of Maryland* — **California**

Fred and George: The Particularities of Becoming a Teacher
Deborah J. Trumbull, Cornell University

Caught between a Rock and a Hard Place: Managing the Dilemmas of Learning to Teach Science
Alberto J. Rodriguez, University of Wisconsin, Madison

Teaching Science in Elementary School: A Narrative of a Preservice Teacher's Attitudes and Perspectives about Science and Science Teaching
Regina Toolin, University of Wisconsin, Madison

Issues in Evaluation and Curriculum (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)

Presider: *Graham Orpwood, York University* — **Monterey**

Understanding Teachers' Evaluation Criteria: A Condition for Success in Science Classes
Ana M. Morais, Clementina Miranda, University of Lisbon, Portugal

Test-taking Strategies: The Relationship between Item Difficulty and Performance
Rebecca J. Pollard, Texas A & M University

Curriculum in Conflict: Ideology and the Differentiation of Classroom Science Knowledge
Michael T. Hayes, University of Utah

Practitioners and Researchers Identifying and Analyzing Student Outcomes: Toward the Development of a Culturally Appropriate Assessment Package for Integrated Science and Mathematics (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Proposer)

Presider: *Arthur L. White, Ohio State University* — **Portola**

An Analysis of Student Outcomes Related to Integrated Science and Mathematics: A Reductionist Canonical Approach
Michael E. Martinez, University of California, Irvine

An Analysis of Student Outcomes Related to Integrated Science and Mathematics: An Applied Taxonomic Approach
Twyla G. Sherman, Catherine Yeotis, Wichita State University

Integrated Science and Mathematics Assessment: Multiple Approaches to Identifying and Analyzing Student Outcomes in Different Cultural Settings
Donna F. Berlin, Ohio State University; John J. Smith, Goshen College

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Gender and Science Interest in a Developmental Perspective: Three Longitudinal Studies (6 Cultural, Social and Gender Issues : Paper Set Grouped by Proposer)

Suite 2601

Presider: *Reinders Duit, University of Kiel, Germany*
Discussant: *Peter Heuson, University of Wisconsin, Madison*
Gender, Science Interest, Teaching Strategies and Social Shared Beliefs about Gender Roles in Seventh Graders: A Multilevel Analysis
Jurgen Baumert, University of Kiel, Germany
Assessment of Students' Interest in Physics as a Means of Improving Instruction
Lore Hoffmann, Peter Häussler, University of Kiel, Germany
An Intervention Study to Enhance Interest and Performance of Girls in Physics Classes
Peter Häussler, Lore Hoffman, University of Kiel, Germany

4:00PM — 5:00PM STRAND SESSION MONDAY 24 APRIL

Pedagogical Philosophies: A Study of Inservice and Preservice Science Teachers (5 Curriculum, Evaluation and Assessment : Interactive Symposium)

Oregon

Presider: *Patricia Simmons, University of Georgia*
Participants:
Patricia Simmons, University of Georgia, Lon Richardson, University of Northern Kentucky

Interpretive Research: A Vehicle for Social Reform (8 History, Philosophy and Epistemology : Interactive Symposium)

Gold Rush A

Presider: *Peter Taylor, Curtin University, Australia*
Discussant: *Nancy Davis, Florida State University*
Participants:
Peter C. Taylor, Loren White, Curtin University, Australia, Mark Campbell-Williams, Edith Cowan University, Australia

Comprehending the Current Guidelines for Science Education Reform (5 Curriculum, Evaluation and Assessment : Invited Session)

Emerald

Presider: *James Gallagher, Michigan State University*
Speaker: *Paul DeHart Hurd, Stanford University*

NARST Outstanding Paper Presentation (10 Others: Special Session)

Gold Rush B

Presider: *Joe Krajcik, University of Michigan*
Presenter: *To be announced*

Publishing in NARST Publications (10 Others : Invited Session)

Redwood

Presider: *Richard Duschl, University of Pittsburgh*
Presenters:
Richard A. Duschl, University of Pittsburgh, William C. Kyle Jr. Purdue University, Larry Scharmann, Kansas State University

High School Students' Understanding and Problem Solving (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Nevada

Presider: *Diana Sue Mason, University of Texas*
Difficulties with Density: The Performance of Grade 9 Students in the USA on a Density Task
Maureen H. O'Rafferty, Rutgers University
Evaluating Conceptual Development in an Integrated Context: The Case of Density and Slope
Susan Westbrook, North Carolina State University, Laura Rogers, University of North Carolina
Conceptual Change in Understandings of Electricity: A Comparison of Instructional Sequences with Voltage vs. Current as the Initial Concept
Joseph Marencik, Shaker Heights High School, John Settlage, Jr. Cleveland State University

Learning Environments (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)

Suite 2601

Presider: *Robyn White, Curtin University*
Study of a Field-developed Model of Scientific Inquiry
David L. Haury, Ohio State University
Research in the Classroom: Implementation of a Regional Program
Michael P. Marlow, University of Colorado at Denver, Stacey E. Marlow, University of Hawaii, Manoa
Associations Between School-level Environment and Science Classroom Environment in Australian High Schools
Jeffrey P. Dorman, Australian Catholic University, Australia, Campbell J. McRobbie, Queensland University of Technology, Australia, Barry J. Fraser, Curtin University, Australia

Improving Teachers' Content Knowledge and Understanding (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *Michael Klapper, Ohio State University* — **Suite 2625**

A Constructivist Model of Professional Development for Science Teachers
Harriett Stubbs, North Carolina State University; Ann C. Howe, University of Maryland

Salient Beliefs about a Demonstration Classroom in Conjunction with a Problem Solving Inservice
Julie L. Wilson, University of Arizona

Perspectives on Teacher-learning and Science at an Elementary Professional Practice School
Sharon E. Nichols, University of Texas

Outreach and Inservice Education (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *William Hug, Pennsylvania State University* — **California**

Synergy: The Connection between Preservice and Inservice Teacher Education
Sheryl McGlamery, James R. Holden, University of North Colorado

FRESCO: A Melding of Research and Practice
Steven M. Uyeda, Los Angeles Unified School District, JodyLee Estrada Duek, UCLA School of Medicine

Follow-up Evaluation of Argonne National Laboratory's Teacher Enhancement Program and Educational Outreach Vehicle
Ray Thomas, Paul Tuss, Randy Landsburgh, Argonne National Laboratory

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Effective Use of Interactive Video in the Classroom (7 Educational Technology : Paper Set Grouped by Committee)

Presider: *Mary Caggiano, Boston University* — **Portola**

An Examination of Science Teachers' Use and Perceptions of Interactive Videodiscs in the Classroom
James D. Lehman, Dianna Brickner, Purdue University

Case Studies of Microcomputer and Interactive Video Simulations in Middle School Earth Science Teaching
David F. Jackson, University of Georgia

The Effects of an Integrated Video-enhanced Chemistry Curriculum on Student Achievement and Attitudes in High School Chemistry
Maureen M. McMahon, William S. Harwood, University of Maryland

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Perspectivas del Ambiente del Salón de Clase (9 Spanish Sessions : Paper Set Grouped by Committee)

Presider: *Alejandro José Gallard, Florida State University* — **Monterey**

Hablando Sobre Ciencias: Perspectivas de Hispanas Sobre Identidad, Ciencia Escolar y el Conocimiento Cientifico
Constanza Hazelwood, Michigan State University

Ciencia, Educacion y Escuela: Un Enfoque Cultural
William Garcia-Bravo, Universidad de Concordia, Montreal

Evaluacion del Programa de Maestria en Ingenieria Quimica de la Universidad de Morelos
Cecilia Cuevas-Arteaga, Universidad de Morelos, Mexico

Students Motivational Patterns and their Preference for Instructional Strategies: A Cross National Study (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Proposer)

Presider: *Geoffrey Giddings, Curtin University, Australia* — **Washington**

Discussant: *Ronald J. Bonnstetter, University of Nebraska, Lincoln*

Motivational Patterns and Instructional Strategies in Science Classrooms in Australian Schools
Geoffrey J. Giddings, Bruce G. Waldrip, Curtin University, Australia

Students Motivational Patterns and Instructional Strategies in STS and Non-STS Science Classrooms in United States Schools
Robert E. Yager, University of Iowa

Students' Motivational Traits and their Preferences for Instructional Techniques in Science Classrooms: The Israeli Case
Avi Hofstein, Sarah Shani, Weizmann Institute of Science, Israel

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5:00PM — 6:00PM NARST BUSINESS MEETING MONDAY 24 APRIL

Gold Rush B

8:00PM — 9:30PM SCIENCE THEATER MONDAY 24 APRIL

Archimedes: To Sink or Not to Sink

Presider: *Susan Stocklmayer, Curtin University, Australia* — **Crystal**

Presenter: *Michael Gore, Questacon, Australia's National Science and Technology Centre*

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TUESDAY April 25

Program Overview

Session	Room	Time
Committee Meetings		7.00 am – 8.30 am
STRAND SESSION		8.30 am – 10.00 am
General Session *Science Teaching in the United States: Implications for Implementing the National Standards* Iris Weiss (Horizon Research, Inc.)	EMERALD	10.30 am – 12.00 pm
Lunch		12.00 pm – 1.00 pm
STRAND SESSION		1.00 pm – 2.00 pm
Unscheduled Committee Meetings		2.30 pm – 3.30 pm
STRAND SESSION		2.30 pm – 3.30 pm
Close of Conference		3.30 pm

TUESDAY April 25

Strand Highlights

Sponsor	Session	Time & Room
STRAND 4	*Science Teacher Education: Issues for a Contemporary Research Agenda* Vincent Lunetta, Thomas Dana, Marvin Druger, Deborah Tippins, Mary Atwater, Léonie Rennie	8.30 am – 10.00 am EMERALD
STRAND 2	*An Analysis of the Role of Language in Inquiry Science Learning: Parts 1 & 2* Michael Kamen, Wolff-Michael Roth, Laura Barden, Bonnie Shapiro, Jay Lemke, Elizabeth Kean, Penny Gilmer, Stephen Marble	1.00 pm – 2.00 pm 2.30 pm – 3.30 pm GOLD RUSH A
STRAND 5	*National Science Education Standards: Results of the National Review* Angelo Collins (Florida State University) Audrey Champagne (SUNY) Rodger Bybee (BSCS)	1.00 pm – 2.00 pm CRYSTAL
STRAND 5	*What Have We Learned from 35 Years of IEA Studies?* John Keeves (Flinders University, Australia)	1.00 pm – 2.00 pm GOLD RUSH B
STRAND 8	*Believing, Knowing and Accepting: Epistemology in Science, Religion and the Science Classroom* Mike U. Smith, Denis Phillips, Stanley Obitts, William W. Cobern, John A. Moore	2.30 pm – 3.30 pm CRYSTAL

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7:00AM — 8:30AM COMMITTEE MEETINGS TUESDAY 25 APRIL

Financial Advisory Committee — Gold Rush A
Presider: *Angelo Collins, Florida State University*

Publications Advisory Committee — Gold Rush B
Presider: *Richard Duschl, University of Pittsburgh*

Program Committee — Redwood
Presider: *Barry J. Fraser, Curtin University, Australia*

International Committee — Oregon
Presider: *Peter Heuson, University of Wisconsin, Madison*

Election Committee — California
Presider: *Kenneth Tobin, Florida State University*

8:30AM — 10:00AM STRAND SESSION TUESDAY 25 APRIL

Reflective Teachers (10 Others : Discussion Group)
Presider: *Lloyd Barrow, University of Missouri, Columbia* — Monterey
Discussant: *Warren Tomkiewicz, Plymouth State University*
Alternative Research Methods: Comparative Pedagogical Profiles and Truth Tables
Luke Sholere, Donnelly College
Implementing Conceptual Change Instruction: One Teacher's Experience
Leslie S. Jones, Michael Beeth, Ohio State University
The Art of Reflecting in a Two-way Mirror: A Collaborative Autobiographical Study by Three Science Educators
John O. Matson, Sharon Parsons, Jim Roban, San José State University
Ecology and Environmental Science Education: A Research Agenda, Year III
Michael Brody, Montana State University

Science Teacher Education: Issues for a Contemporary Research Agenda (4 Teacher Education : Interactive Symposium)
Presider and Discussant: *Vincent Lunetta, Pennsylvania State University* — Emerald
Participants:
Vincent Lunetta, Thomas M. Dana, Pennsylvania State University; Marvin Druger, Syracuse University; Deborah Tippins, Mary Atwater, University of Georgia, Léonie Rennie, Curtin University, Australia

Introduction to the Monograph "Gender Equity and Science Education" (6 Cultural, Social and Gender Issues : Interactive Symposium)
Presider: *Bambi Bailey, University of Delaware* — Gold Rush B
Participants:
Dale Baker, Arizona State University; Kathryn Scantlebury, University of Delaware

Can We Integrate Qualitative and Quantitative Research in Science Education? Lest the Crevice May Become a Canyon (10 Others : Interactive Symposium)
Presider: *Russell Yeany, University of Georgia* — Crystal
Participants:
Mansoor Niaz, Universidad de Oriente, Venezuela; Wolff-Michael Roth, Simon Fraser University; Michael Matthews, University of New South Wales, Australia; Ken Tobin, Florida State University; Ron Good, Louisiana State University

College Students and Effective Learning (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)
Presider: *Tina Jarvis, University of Leicester, England* — Washington
College Students' Conceptions of Science and Science Content
Philip Wade, Norman Lederman, Oregon State University
Examination-type Preferences of College Science Students and Their Faculty in Israel and USA: A Comparative Study
David Ben-Chaim, Uri Zoller, Haifa University-Oranim, Israel; Steven D. Kamm, Oklahoma City Community College
Learning Issues Identified by Students in Tutorless Problem-based Tutorials
JodyLee E. Duek, LuAnn Wilkerson, UCLA
The Role of Graduate Teaching Assistants and Alternative Instructional Technologies in Teaching Problem Solving in General Chemistry
Mark S. Cracolice, University of Montana; Michael R. Abraham, University of Oklahoma

High School Students' Understanding (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Presider: *William Cobern, Arizona State University West* — **Oregon**

A Study about Naive Concepts of the Solar System Based on Investigation of Junior High School Students by Questionnaire Method
Mariko Suzuki, Yubei Yamauchi, Katsuo Sugai, Osaka University, Japan

Discovering Naive Intuitions in Heat Related Problems
Sharadh Naidoo, Aletta Zietsman, University of the Witwatersrand, South Africa

Students' Conceptual Representations of Gas Volume in Relation to the Particulate Model of Matter
Bao-Tyan Huang, National Taiwan Normal University, Taiwan

Changing Student Understanding of and Attitudes to Physics during the Learning of Heat and Temperature Using an Inquiry Approach
Allan G. Harrison, Curtin University, Australia, Diane Grayson, University of Natal, South Africa

High School Students' Learning Contexts (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)

Presider: *Stephen Ritchie, James Cook University, Australia* — **Nevada**

Beating the System: Confronting Student Behaviors that Inhibit Conceptual Understanding of Introductory Physics
Valarie Dickinson, Washington State University, Larry Flick, Oregon State University

Problem Solving in Science Lessons: How Students Explore the Problem Space
Ken Appleton, Central Queensland University, Australia

The Role of Routine Problem Tasks in the Teaching of Physical Science
Paul Hobden, University of Natal, South Africa

Students' Perceptions of Senior High School Physics
Keith B. Lucas, Queensland University of Technology, Australia

Perspectives on Curriculum Reform (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)

Presider: *Helen Parke, East Carolina State University* — **Redwood**

Curriculum Reform in Namibia
Wout Ottevanger, The Instanf Project, Namibia, Jan van den Akker, University of Twente, The Netherlands

The Implementation of Context and Activity Based Science Education: Intentions and Reality
Wilmad Kuiper, University of Twente, The Netherlands

The Effectiveness of the Iowa Scope, Sequence and Coordination Project: A Holistic Teacher Enhancement Study Focusing on Teacher and Student Changes
Chin-Tang Liu, Robert E. Yager, University of Iowa

Physics Curriculum Reform: Teacher Initiated Change?
David A. Wood, Secondary Education Authority, Western Australia

Understanding and Practice (8 History, Philosophy and Epistemology : Paper Set Grouped by Committee)

Presider: *Gregory Kelly, University of California at Santa Barbara* — **California**

Science Education's Selective Reading of the History and Philosophy of Science: The Case of Project 2061
Nicole E. Holthuis, Julie Bianchini, Vicky Webber, Stanford University

What's so Special about Science? How Six Secondary Science Teachers View the Nature of Science
Jenifer V. Helms, Stanford University

Schematic Structure of Scientific Concepts: The Case of Physics
Ibrahim A. Halloun, Arizona State University

Translation and Transformation of Teachers' Understanding of the Nature of Science into Classroom Practice
Norman G. Lederman, Oregon State University

Teacher Cognition in the Integrated Mathematics and Science Classroom (3 Teaching : Paper Set Grouped by Proposer)

Presider: *Gerald Kulm, Montana State University* — **Gold Rush A**

Discussant: *Richard Lesh, Educational Testing Service*

TARPS I: Demonstration of the Teachers As Research Partners (TARPS) Model
Dawn Parker, Texas A & M University, Robert Borjes, Kerrville Independent School District, Andrea Foster, Northside Independent School District

TARPS II: An Overview of the Teachers as Research Partners Model
Patricia A. Alexander, Gary R. Tucker, Texas A & M University

TARPS III: Implications of the TARPS Model for Balancing Content and Process in Integrated Contexts
Carol L. Stuessy, Kim Dooley, Texas A & M University

TARPS IV: Implications of the TARPS Model for Teacher Educators in Modeling Balanced Learning Environments
Stephanie L. Knight, Dawn Parker, Texas A & M University

TARPS V: Implications of the TARPS Model from the Instructional Technology Perspective
Gary R. Tucker, Carol L. Stuessy, Texas A & M University

Science Teaching and Learning in Bilingual Settings (6 Cultural, Social and Gender Issues : Paper Set Grouped by Proposer)

Presider: *Michael Aiello, The Ohio State University* — Suite 2601

Discussant: *Alejandro Gallard, Florida State University*

A Content Analysis of Science Methods Texts: What are we Told about the Bilingual Learner?
Elizabeth Bernhardt, Ohio State University

Enhancing the Performance of Hispanic Students: The AVANCE Project in the High School
Trish Stoddart, Thomas Destino, University of California, Santa Cruz

Observing a Bilingual Teacher Accommodating both Science and Language Objectives
Thomas Destino, University of California, Santa Cruz

Linking Scientific Literacy and Language Development in a Bilingual Setting
Marisol Rodriguez Munoz, Gladstone Elementary School

Navigating the Electronic Frontier: Using Multimedia Technologies in Elementary and Middle School Settings
(7 Educational Technology : Paper Set Grouped by Proposer)

Presider: *Richard Williams, University of Victoria* — Portola

Teachers' Perceptions of the Use and Effect of Telecommunications in Teaching and Learning in Three Middle Schools
Nikki Burger, Pierce Farragher, University of Victoria

Developing a Computer-based Portfolio System by Means of Action Research
Pierce Farragher, University of Victoria, Bryan Potter, Sooke School District

Exploring the Potential of Multimedia in Teaching Intermediate Science
Joe Greuel, Pierce Farragher, University of Victoria

10:30AM — 12:00PM GENERAL SESSION TUESDAY 25 APRIL

Science Teaching in the United States: Implications for Implementing the National Standards

Presider: *Jane Butler Kable, Miami University (Ohio)* — Emerald

Speaker: *Iris Weiss, Horizon Research, Inc.*

12:00PM — 1:00PM LUNCH TUESDAY 25 APRIL

1:00PM — 2:00PM STRAND SESSION TUESDAY 25 APRIL

National Science Foundation Initiatives in Teacher Preparation (10 Others: Interactive Symposium)

Presider: *Arthur White, Ohio State University* — Oregon

Discussant: *Deborah Tippins, University of Georgia*

Participant:
Terry S. Woodin, National Science Foundation

An Analysis of the Role of Language in Inquiry Science Learning: Part 1 (2 Learning: Classroom Contexts and Learner Characteristics : Interactive Symposium)

Presider: *Larry Flick, Oregon State University* — Gold Rush A

Participants:
Michael Kamen, Auburn University; Wolff-Michael Roth, Simon Fraser University; Laura Barden, University of Tennessee at Knoxville; Bonnie Shapiro, University of Calgary; Jay Lemke, City University of New York; Elizabeth Kean, University of Nebraska, Lincoln; Penny Gilmer, Stephen Marble, Florida State University

Note: This session is continued in the next Strand Session

National Science Education Standards: Results of the National Review (5 Curriculum, Evaluation and Assessment : Interactive Symposium)

Presider: *Angelo Collins, Florida State University* — Crystal

Participants:
Angelo Collins, Florida State University; Rodger Bybee, Biological Sciences Curriculum Study; Audrey Champagne, State University of New York at Albany

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What Have We Learned from 35 Years of IEA Studies? (5 Curriculum, Evaluation and Assessment : Invited Session)

Presider: *Doris Jorde, University of Oslo, Norway* — **Gold Rush B**
Discussant: *Theo Wubbels, University of Utrecht, The Netherlands*
Presenter: *John P. Keeves, Flinders University, Australia*

Learning for Conceptual Change (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Presider: *Heidi Kass, University of Alberta* — **Portola**

Learning Strategies and Their Influence Upon Students' Conceptions of Science Literacy and Meaningful Learning: The Case of a College Chemistry Course for Nonscience Majors
Stacey Lowery Bretz, University of California

Formal Reasoning Abilities as Predictors of Academic Achievement
Valanides Nicolaos, University of Cyprus, Cyprus

The Effect of Mastery Learning Strategy on the Achievement of Science Students in College Chemistry
Moisés Camacho, Interamerican University of Puerto Rico, Puerto Rico

New Teachers: Views of Understanding (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *Allan Harrison, Curtin University, Australia* — **Washington**

Misconceptions Held by New Science Teachers
William J. Pankratius, University of Nevada at Las Vegas

Elementary Science Instruction: Are Teachers Prepared to Teach What Their Students Must Master?
Diana C. Rice, Margaret R. Corboy, University of South Carolina, Aiken

Portfolios for Preservice Teacher Education: Procedures and Promises
Anthony W. Bartley, Lakehead University

Teachers in Profile (4 Teacher Education : Paper Set Grouped by Committee)

Presider: *Liz Dozier, University of Georgia* — **Nevada**

Examining the Multiplier Effect of a Statewide Elementary Science Inservice Program
Joseph P. Riley, Tom Elliott, Lisa Gansar, Lena Lane, University of Georgia

Malaysian Student Teachers' Conception of the Nature of Science
Mohd I. Hamid, Zurida Ismail, Universiti Sains Malaysia, Malaysia

A Profile of Biology Teachers in the USA
Ivo E. Lindauer, University of Northern Colorado; Mary Queitzsch, National Science Foundation

Gender and Equity: College Perspectives (6 Cultural, Social and Gender Issues : Paper Set Grouped by Committee)

Presider: *Bob Evans, Wake Forest University* — **Suite 2601**

Research Internships for Freshwomen, College Science Histories and the Retention of Women in Science: A Formative Evaluation of the Women in Science Project (WISP)
Christine M. Cunningham, Cornell University; Mary L. Pavone, Carol Muller, Dartmouth College

A Profile of Undergraduate Women Considering Graduate Study in Science
Judith G. Glick, Oregon State University

Despite What the Research Suggests, Many Women are as Good as Men in Visual Spatial Aptitude
Thomas R. Lord, Indiana University of Pennsylvania

Problemas de Matemática y Ciencias (9 Spanish Sessions : Paper Set Grouped by Committee)

Presider: *Alfonso Gomez, Pontificia Universidad Javeriana, Colombia* — **California**

Genisis de la Demostracion Matematica
Egberto Agard, Universidad de Panama, Panama

La Relacion Entre la Actividad Productiva y los Procesos de Pensamiento Implicados en la Solucion de Problemas
Nancy Ayala, Centro Profesional Panamericano, Colombia

Las Leyes de Kepler: Un Ejemplo de Ensenanza Integrada de Matematicas y Fisica Utilizando la Computadora como Herramienta
Estela Navarro, Aniceli Reyes, Maria Trigueros, Centro Latinoamericano de Investigación Educativa, IBM de Mexico

Action Research and Critical Theory: Addressing Relevance and Accountability in Science Education Research (10 Others : Paper Set Grouped by Proposer)

Presider: *Mary Nakhleh, Purdue University* — **Redwood**

A Critical Examination of Relevance in Science Education Research
George Bodner, Dan MacIsaac, Purdue University

An Introduction to Critical Theory in Education Research
Kirsten Lourey, Dan MacIsaac, Purdue University

Curriculum Reformation in Undergraduate Physics Laboratories via Action Research
Dan MacIsaac, Purdue University

ROUND TABLES — EMERALD

Presider: *Peter Rillero, Arizona State University*

1 Learning: Students' Conceptions & Conceptual Change

Conceptual Change in High School Chemistry: A Multidimensional Scaling Approach
Ruth Streveler, Colorado School of Mines

Science Meets Education: Interfaculty Collaboration to Implement Change in a Large Undergraduate Problem Solving Course
Jolie A. Mayer-Smith, Anthony J. F. Griffiths, University of British Columbia

Creating a Learning Environment to Induce Development in the Control of Variance Thinking Strategy
Ansat Zohar, Technion – Israel Institute of Technology, Israel

Kinds of Mental Representations – Models, Propositions and Images – Used by Physics Students and Physicists Regarding the Concept of Field
Marco A. Moreira, Ileana Greca, Instituto de Fisica UFRGS, Brazil

2 Learning: Classroom Contexts and Learner Characteristics

Space and Time: An Ontological Analysis of Contextualized Relations between Subjects and Objects in an Eighth-grade Science Classroom
Ruth Bombaugh, University of Michigan

4 Teacher Education

The Recruitment of Academically Talented Science Majors into Teacher Education
Debra Tomanek, North Dakota State University

The Relationship between Preservice Elementary Science Teachers' Efficacy and Methods of Instruction during Student Teaching
Stanley J. Henson, Arkansas Tech University

Helping Teachers to Pursue Nature's Questions: Teachers' Changing Conceptions of Science and of Teaching Science
Herman G. Weller, Mary Dickinson Bird, University of Maine

6 Cultural, Social and Gender Issues

Students' World View Relative to their Level of Science Learning and Socioeconomic Background
Emmanuel O. Odubunmi, Lagos State University, Nigeria

Can At-risk Students Envisage Their Potential to be Scientists?
Sunethra Karunaratne, Michigan State University

Language, Culture and the Learning of Science: An Empirical Study Based on Venda-speaking and Tsonga-speaking Students' Understanding of the Solar System
Patrick Dooms, Paddy Lynch, University of Witwatersrand, South Africa

8 History, Philosophy and Epistemology

The Need for a Biologically-based Epistemology
Lon Richardson, University of Northern Kentucky

10 Others

The Influence of a Constructivist-based Elementary Science Curriculum on At-risk Students
Katheryn Grimes, Gwendolyn Wooley Elementary School; Richard R. Powell, Texas Technical University

Enhancing Networking at and Beyond NARST: An Overview of the NARST Committee for the Enhancement of Individual Networking
Katherine Norman, University of Texas

2:30PM – 3:30PM — STRAND SESSION — TUESDAY 25 APRIL

An Analysis of the Role of Language in Inquiry Science Learning: Part 2 **(2 Learning: Classroom Contexts and Learner Characteristics : Interactive Symposium)**

Presider: *Larry Flick, Oregon State University* — **Gold Rush A**

Participants:
Michael Kamen, Auburn University; Wolff-Michael Roth, Simon Fraser University; Laura Barden, University of Tennessee at Knoxville; Bonnie Shapiro, University of Calgary; Jay Lemke, City University of New York; Elizabeth Kean, University of Nebraska, Lincoln; Penny Gilmer, Stephen Marble, Florida State University

Note: This session is continued from the previous Strand Session

Believing, Knowing and Accepting: Epistemology in Science, Religion and the Science Classroom **(8 History, Philosophy and Epistemology : Interactive Symposium)**

Presider: *Mike U. Smith, Mercer University* — **Crystal**

Discussant: *Denis Phillips, Stanford University*

Participants:
Mike U. Smith, Mercer University; Stanley Obitts, Vermont College; William W. Cobern, Arizona State University West; John A. Moore, University of California at Riverside; Denis Phillips, Stanford University

Listening to Other Voices by Broadening the Theoretical Dialogue: Theories of Integrating and Self-regulating Reading and Writing, Speech and Communication and Play (10 Others : Interactive Symposium)

Redwood

Presider: *William G. Holliday, University of Maryland*
Discussant: *John J. Koran, Jr, University of Florida*
Participants:
William G. Holliday, J. Randy McGinnis, Maureen M. McMahon, Nancy W. Wiltz, Stefbanie A. Stockman, Christine M. Kelly, University of Maryland

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Elementary Students' Understanding of Concepts in Physics (1 Learning: Students' Conceptions & Conceptual Change : Paper Set Grouped by Committee)

Nevada

Presider: *Susan Westbrook, North Carolina State University*
Children's Concepts about Force and Motion Before and After Using a Science Textbook in the Fifth Grade of Elementary School
Jong-Pyng M. Chyuan, National Taipei Teachers College, Taiwan
Children's Figural and Operational Knowledge of Sound
Lynn Sharp, Schweitzer Elementary School, CA; Patricia F. Keig, California State University
Fourth Graders' Interpretive Frameworks for Understanding Electric Circuits
Daniel P. Shepardson, Purdue University; Elizabeth Moje, University of Utah

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Laboratory Experiences and Hands-on Activities (2 Learning: Classroom Contexts and Learner Characteristics : Paper Set Grouped by Committee)

Washington

Presider: *Maureen O'Rafferty, Rutgers University*
An Evaluation of a Hands-on Science Homework Program for Sixth Grade Students and Their Parents
Peter Rillero, Arizona State University West; Stan Helgeson, Ohio State University
Science Laboratory Classrooms in Developing and Developed Countries
Bruce G. Waldrip, Geoffrey J. Giddings, Curtin University, Australia
Student Engagement in a Laboratory Research Project
Stephen M. Ritchie, Donna L. Rigano, James Cook University, Australia

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Attitudes of Preservice Teachers (4 Teacher Education : Paper Set Grouped by Committee)

Monterey

Presider: *Patricia Morrell, Oregon State University*
Changes in Perceptions and Attitudes of Preservice Postgraduate Secondary Science Teachers' Students
Nir Orion, Weizmann Institute of Science, Israel; David Thompson, University of Keele, England
Attitudinal Differences between Preservice and Inservice Teachers toward Inquiry-based Science
Arta Damnjanovic, Jane Butler Kahle, Miami University (Ohio)
How Subject Matter Influences Beginning Teachers Perceptions of Teaching
Barbara Moon, Marvin Wideen, Simon Fraser University; Jolie Mayer-Smith, University of British Columbia

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Large-scale Curriculum and Assessment Initiatives (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Committee)

California

Presider: *Susan Stocklmayer, Curtin University*
Restructuring the Content and Instruction of the Mathematics and Science Courses for Elementary Education Teachers
Teresa M. Koloski, Anne Madsen, Walter Thomas Kyner, University of New Mexico
The Design and Rationale of the New Michigan Educational Assessment Program in Science
Edward L. Smith, Michigan State University
Implementing a National Curriculum in Elementary Education: Issues and Implications
Rae Stark, University of Strathclyde, Scotland

Initiatives in Educational Technology (7 Educational Technology : Paper Set Grouped by Committee)

Portola

Presider: *Timothy Olsen, University of Wisconsin*
The Scientists in Action Series: Scientific Inquiry for Authentic Learning Environments
Robert D. Sherwood, Xiaodong Lin, Vanderbilt University
How Can We Use a Computerised Database to Enhance Students' Understandings in the Science Classroom?
Dorit Maor, Curtin University, Australia
Students' Use of Multimedia Science Instruction: The MTV Generation?
Carl Berger, Trisha Jones, Charles Dershimer, University of Michigan

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In-school and Out-of-School Perspectives (10 Others : Paper Set Grouped by Committee)

Suite 2601

Presider: *Lon Richardson, University of Northern Kentucky*
Gender, Structure of Out-of-School Experiences, Motivation and Science Learning in School
Robert H. Evans, Wake Forest University; Jürgen Baumert, Helmut Geiser, University of Kiel, Germany
The Effects of a Hands-on Environmental Science Program on the Attitudes and Career Interests of "Young Scholars"
Andrew A. McConney, Western Michigan University; Phillip B. Horton, Florida Institute of Technology

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New Developments for Teacher Educators in Science about Gender Equity (4 Teacher Education : Paper Set Grouped by Proposer)

Presider: *Jo Sanders, City University of New York* — **Oregon**

Accounting for Profound Educational Change in Gender Equity
Jo Sanders, City University of New York

Involving Preservice Students in a Gender Equity Project
Susan Chevalier, Boise State University

An Examination of Gender Equity Attitudes at a Conservative Protestant University
Ray Ostrander, Andrews University

Science Curriculum Reform: Case Studies and a Cross-site Analysis (5 Curriculum, Evaluation and Assessment : Paper Set Grouped by Proposer)

Presider: *Philip Wade, Oregon State University* — **Gold Rush B**

Discussant: *Jane Butler Kahle, Miami University (Ohio)*

Change is Hard: Pathways and Obstacles to Curricular Reform
Kathleen S. Davis, University of Colorado

Curriculum Reform: A Case Study of Fairview Middle School
Joan M. Whitworth, University of Colorado

A Cross-site Analysis of Case Studies of Science Reform
Ronald D. Anderson, University of Colorado

ROUND TABLES — EMERALD

Presider: *William Barowy, BBN Systems and Technologies*

4 Teacher Education

Eeks and Geeks: Influencing Elementary Teachers' Views of Science and Scientists
Mary Dickinson Bird, Herman G. Weller, University of Maine

A Case Study of Preservice Chemistry Teachers Pedagogical Content Knowledge Development
Hsiao-Lin Tuan, Bin-Yun Jen, Lyee-Juan Whang, Rong-Chen Kaou, National Changhua University of Education, Taiwan

Transfer of Knowledge Through Expatriate Nationals (TOKTEN): The Role of Culture in the Delivery of a Science Curriculum Project in Nigeria
David B. Deru, Joseph P. Riley, II, University of Georgia

6 Cultural, Social and Gender Issues

The Biological and Physical Science Interests of Gifted Kindergarten Girls
Sandra Johnson, Texas Education Service Center

A Case Study of a Science and Mathematics Day Camp as Experienced by Six Girls from Rural Georgia
Marti Schriver, Lynn Wolfe, W. Jay Strickland, Georgia Southern University

Attitudes and Expectations of Students and Teachers Toward Science and Science Teaching in South African High Schools
Khumbulani D. Mdletshe, Jacob Manale, Paddy Lynch, University of Witwatersrand, South Africa

8 History, Philosophy and Epistemology

An Attainable Version of Intellectual Independence for Nonscientists
Stephen P. Norris, Memorial University of Newfoundland

10 Others

Testing Stimuli and Associated Neurophysiological Responses: Methodological Problems Related to Digital Analysis of Analogue Data
William J. Kermis, Southwestern Oklahoma State University

We Need Heroes in Science Education: Fact or Fiction?
Robyn White, Curtin University, Australia

Historical Reporting of Teaching-learning Experiences in Iowa SS & C: A New Type of Teaching Module
Chris Lawrence, Robert Yager, University of Iowa

PART C

Abstracts

Abell, Sandra K.

Strand 4 — Sun, 23 Apr, 1995, 8:30 AM, Washington

Investigating the Process of Becoming Reflective: The Use of Video Cases in Elementary Science Teacher Preparation

Lynn A. Bryan, Maria Anderson, Lois M. Campbell, Katherine S. Cennamo, J. William Hug

The purpose of this study is to interpret preservice elementary science teachers' reflections in the context of interactive video case-based instruction and to construct a deeper understanding of their thinking about science teaching and learning. Students in elementary methods courses at our respective universities participated in a series of written and oral reflection tasks in response to a videodisc case of a Grade 1 teacher teaching a series of conceptual change lessons about seeds and eggs. Our findings have helped to generate a number of assertions. The personal science histories of elementary education majors and their visions of themselves as teachers of science are dialectically related. Although these future teachers come into the science methods course with local theories about science teaching and learning, their theories exhibit inconsistencies and a lack of depth. Our findings have implications for the preparation and continuing education of elementary science teachers.

Abraham, Michael R.

Strand 5 — Sun, 23 Apr, 1995, 8:30 AM, Suite 2625

The Nature and State of General Chemistry Laboratory Courses Offered by Colleges and Universities in the United States

Mark S. Cracolice, A. Palmer Graves, Abdulwali H. Aldahmash, Joann G. Kihega, Julieta Palma Gil, Valsamma Varghese

The purpose of our study is to answer the following questions: How is general chemistry laboratory taught and managed? What variety of practices is being used? A sixty-item survey instrument was developed which would describe the first general chemistry course taken by science majors at a college or university. The instrument was comprised of eight major sections: (1) laboratory administration, (2) laboratory goals, (3) laboratory procedures, (4) laboratory instructor preparation, (5) laboratory instructor behaviors, (6) teaching assistant qualifications, (7) laboratory assessment and, (8) laboratory equipment and instrumentation. The sample consisted of the top colleges and universities in the United States accredited by the American Chemical Society. From this sample, 300 institutions were randomly selected and sent a survey by mail. A total of 204 responses have been received.

Abrams, Eleanor D.

Strand 5 — Sun, 23 Apr, 1995, 8:30 AM, Monterey

A Comparison of the Effects of Multiple Visual Examples and Nonexamples versus Prototypical Examples on Science Concept Learning

J. H. Wandersee

Two video scripts on photosynthesis (and accompanying ancillary materials) were developed with the input of educators and content experts. The control video script contained the standard number of prototypical examples and graphics. The treatment video script, based on the theory of conceptual change, used a carefully selected set of examples and nonexamples to explore the concept of photosynthesis. Two student focus groups met daily for one week and reviewed portions of the original treatment script for clarity, brevity and choice and placement of examples and nonexamples. Their suggestions were subsequently incorporated into the revised video script. All of the students participating in the study took a concept-based pretest on the day before they experienced either a treatment or control photosynthesis video program. Afterwards, they were asked to generate sets of novel examples related to the concept of photosynthesis, take a posttest one day after the video and take another posttest two weeks later. Eighteen students were interviewed. The data has implications for curriculum design. The student focus groups were crucial in helping choose the needed examples and nonexamples for this curriculum module to help initiate conceptual change. These focus groups provided common language and connections to everyday life.

Adey, Philip

Strand 4 — Mon, 24 Apr, 1995, 10:30 AM, Gold Rush B

The Effects of a Staff Development Program: The Relationship Between the Level of Use of Innovative Science Curriculum Activities and Student Achievement

Criticisms of process-product research in teacher education are reviewed. The significant effects obtained in terms of student cognitive development as the result of a Cognitive Acceleration through Science Education (CASE) program are related directly to teachers' Levels of Use of the program and hence to the inservice education program used to introduce the methods into classrooms. It is concluded: (1) the CASE inservice program is effective, and (2) process-product research is defensible and can be viable.

Agard, Egberto

Strand 9 — Tue, 25 Apr, 1995, 1:00 PM, California

La Genisis de la Demostración Matemática

El propósito de este articulo es el de hacer un estudio de la génesis de la demostración matemática en la Ciencia Antigua y mostrar que existen neiveles de distrinción. Mostramos por medio del razonamiento por el absurdo, que /2 (raíz de dos) es un número irracional. Se concluye recomendando la incorporación de las "pruebas" en el Bachillerato del Sistema Educativo Panameño.

Agard, Egberto

Strand 3 — Sun, 23 Apr, 1995, 7:00 PM, Exploratorium

The Genesis of the Mathematics Demonstration

English presentation of the topic above

Akatugba, Ayo H.

Strand 1 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

The Effects of Problem Context and Gender on Students' Proportional Reasoning Ability

The study investigated the effects of problem context on the proportional reasoning ability of physics students. Three ratio types (speed, exchange and consumption) and their hierarchy of difficulty were investigated for both familiar and unfamiliar settings. The performance of boys and girls on a physics (proportional reasoning) achievement test was also investigated. Three hundred students from twenty randomly selected secondary schools in Nigeria were used for the study. The results showed that ratio types used in physics problems influence students' performance. Students found consumption ratios more difficult than exchange ratios, and exchange ratios more difficult than speed ratios. Tasks with unfamiliar settings appeared to be more difficult for the students than those with familiar settings. There was a significant difference in the performances of girls and boys favouring boys. The average proportional reasoning ability of the students used for the study was found to be generally low. The implications of the results are discussed and some recommendations are made.

Alexander, Patricia A.

Strand 3 — Tue, 25 Apr, 1995, 8:30 AM, Gold Rush A

TARPS II: An Overview of the Teachers as Research Partners Model

Gary R. Tucker

This segment of the paper set formally introduces a model for teacher cognition and its associated visualization technology that stimulates teachers to consider the effectiveness of lessons in a sequence in a multidimensional and contextual manner. In the model, teachers are prompted to plan lessons by considering their students' expertise in four critical dimensions: general strategies, domain-specific strategies, content and instructional strategies. Then, teachers ascertain how familiar or unfamiliar students are with each of these dimensions (i.e. novelty) and how cognitively demanding each appears to be for the learners (i.e. complexity). Of importance in these determinations is how these four dimensions interact with one another to produce a lesson profile that estimates the learning demand of the lesson. If a lesson or series of lessons is consistently high in most of the dimensions, then the overall learning demand may be overwhelming to the students. Conversely, if a lesson is not very complex or novel on any of the dimensions, the learning demand may lower student motivation or persistence. Lessons that seem to overwhelm or underwhelm students are, thus, assumed to be less effective and less likely to enhance achievement or motivation.

Allen, Nancy

Strand 6 — Mon, 24 Apr, 1995, 10:30 AM, California

"Voices from the Bridge": Kickapoo Indian Students and Science Education: — A World View Comparison

The purpose of this study was to compare the world view of Native American students with the world view encountered in the multicultural science classroom. Qualitative data were collected from periodic observations in two classrooms over a nine-month period, teacher interviews and text evaluations to define scientific world view as presented in classroom instruction. To define student world view, 28 students in Grades 5-9 were engaged in science activities at the reservation and interviewed singularly and in groups. Adult Native Americans were interviewed and asked to reflect on the educational cultural norms of the students. A variable-oriented analysis revealed strong differences in epistemology, preferred methods of teaching and learning, values, structural orientation and perspective of the place of humans in the natural world. Strong differences between teachers and students were also observed in prior knowledge, cultural rules for behavior and language patterns. Worldview investigations may help us understand the problems of students from non-western cultures in the contemporary multicultural science classroom.

Allen, Sue

Strand 1 — Sun, 23 Apr, 1995, 10:30 AM, Portola

An Emphasis on Perception: Teaching Image Formation Using a Mechanistic Model of Vision

Barbara White John Frederiksen

This study investigated students' understanding of image formation in geometrical optics. We believe that many of the difficulties students experience in this domain arise because they lack an adequate model of human visual perception. Our hypothesis was that an effective way to define *image* was in terms of a mechanistic model of an observer who interpreted incoming light patterns in predictable ways. To test this we developed a model in which eyeball convergence is the principle cue for identifying the location of an object or image. Students aged 14-15 were taught the fundamentals of image formation either using the mechanistic model, or using a more traditional approach in which image is defined geometrically as the crossing points of multiple rays. The latter version of instruction included an observer, but one without an explicit inferencing mechanism. The results show that students who were taught a mechanistic model of vision exhibited a better understanding of the notoriously difficult relationship between an observer and a virtual image. They were also better able to identify the location of an image in real-world optical situations and were less likely to think of it as located on the surface of a mirror or lens.

Allen, William A.

Strand 10 — Mon, 24 Apr, 1995, 10:30 AM, Portola

Cognitive and Psychological Factors Affecting LVN Students' Success at Solving Medication Dosage Calculation Problems

Frank E. Crawley

The purpose of this study was to describe the cognitive and psychological factors that either enhanced or inhibited Licensed Vocational Nurse (LVN) students' abilities to solve medication dosage calculation problems. A purposive, maximum-variation sample of six LVN students was chosen from among a self-selected population of junior college LVN students. The students' views and feelings concerning their training and clinical experience in medication administration was explored using a semi-structured interview. In addition, the students were asked to participate in a talk-aloud as they attempted to solve two medication calculation problems of differing difficulty. Results indicated that many students were lost during most of the problem solving instruction in class and relied on algorithmic devices to calculate medication dosages. Students often felt that medication problem solving done as class work did not reflect the reality of their clinical experience. Finally, although students had similar high school mathematics backgrounds and recent classroom and clinical experience, those students who successfully solved medication problems were the ones that consistently identified the goal, restructured the data, estimated the result, selected an appropriate algorithm from memory and were able to do the necessary arithmetic manipulations.

Anderson, David

Strand 10 — Sun, 23 Apr, 1995, 8:30 AM, California

The Effectiveness of Orienting Students to the Physical Features of a Science Museum Prior to Visitation

Keith Lucas

This paper reports on recent research in the area of informal science education in the contexts of science museums. The research focuses upon two areas: perceived novelty and its effect on cognitive learning in Year 8 students visiting an interactive science museum and the links between cognitive learning as derived from science museum exhibits and exhibits which students later nominated as being interesting and puzzling. It was found that students who underwent novelty reducing pre-orientation to the physical environment and had prior visitation experience derived greater cognitive knowledge than any of their counterparts. Gender did not have any significant effect on learning when perceived novelty level and prior exposure were considered. Analysis of student responses suggested that the most interesting, puzzling and memorable exhibits may be linked with cognitive learning outcomes. These exhibits stood out from other exhibits by their large physical size, prominence in the exhibit galleries and the diversity of sensory modes that they employed.

Anderson, Linda M.

Strand 4 — Sun, 23 Apr, 1995, 1:00 PM, California

How Do Prospective Science Teachers Learn from Teacher Education? The Influence of Their Entering Conceptions about Science and Teaching

Kathleen L. Peasley

This paper describes the learning of three prospective elementary science teachers by focusing on their conceptions about the nature of science and scientific inquiry and about science teachers' roles and responsibilities. While all three prospective teachers progressed in their knowledge of how to teach science and all three transformed their initial conceptions in significant ways, they did not travel the same paths, nor did they arrive at their final conceptions with equally rich understanding about how teachers help learners construct understanding in science. The profiles of the three students reveal the ways in which they differed and what ideas and events had the greatest impact on each of them, given their particular conceptions. While the data certainly do not provide prescriptions for teacher educators about how to teach about science teaching, they do provide insight into the students we teach and suggest how teaching educators might inquire into their students' conceptions, much as we so often recommend to K-12 science teachers.

Anderson, Ronald D.

Strand 5 — Tue, 25 Apr, 1995, 2:30 PM, Gold Rush B

A Cross-site Analysis of Case Studies of Science Reform

The purpose of this endeavor was to conduct a cross-site analysis of three case studies of science curriculum reform to identify commonalities in reforms achieved, barriers encountered, dilemmas experienced by teachers and the means by which reforms were accomplished. The methodology employed draws upon the work of Miles and Huberman (1984) and Rossman (1992). The steps include bounding the scope of the synthesis, inventorying the cases, repeated reading of the studies, developing an interpretation of each case, juxtaposing the cases, synthesizing the cases and writing the synthesis. More major areas as: (1) goals, (2) content, (3) teachers' role, (4) students' role, (5) student work and, (6) assessment. In each of these major areas, attention is given to the following three dimensions: (1) tensions, (2) accomplishments and, (3) recommendations.

Antony, Mary

Strand 6 — Sat, 22 Apr, 1995 7:00 PM Monterey

African-American Students' Opportunities to Learn Science: The Role of Middle School Scheduling

David E. Blair

The ethnographic study focuses on the schools' contribution to inequalities in science education. The objective was to examine the processes by which students and teachers are assigned to different classes and the consequences of this assignment on African-American students' opportunities to learn science. Three interconnected research strategies viz. non-participant observation, interviewing and collection of printed documents were adopted in order to enable a holistic analysis and through the process of triangulation to enhance the validity of the study. Findings of the study suggest that the school schedule is not a neutral or impartial document. Rather it is the product of socially constructed institutionalized practices that often, albeit unwittingly contribute to inequality. Scheduling begins by assigning students to Band which is the largest elective class. Most students in Band are white or from higher social class. Most students in Grade 8 algebra are also white. Band and Algebra students are scheduled into morning science classes. Afternoon science classes are larger, have more African-American students and are perceived as being "lower track". Teacher expectations vary depending on the class. These differential expectations are translated into different curriculum goals and instructional activities. Consequently African-American students in this middle school get very different opportunities to learn science than their white peers.

Appleton, Ken

Strand 2 — Tue, 25 Apr, 1995 8:30 AM Nevada

Problem Solving in Science Lessons: How Students Explore the Problem Space

This article examines, from a constructivist framework, how students presented with discrepant event problems during science lessons begin the problem solving process by exploration of the problem space. Three discrepant events were presented to several classes of eleven to thirteen year olds using three different teaching strategies. The teaching strategies used teacher demonstrations followed by students asking the teacher questions, teacher demonstrations followed by an explanation by the teacher and small groups of students under the guidance of the teacher. Data were collected from field notes, video tapes of the lessons and student interviews using a stimulated recall technique to elicit the students' thinking during the lessons. The students' ability to explore the problem space was found to be determined by the teaching strategy used, as the first and last strategies encouraged students to find their own explanations. Different information sources were also available in each of the teaching strategies. None of the teaching strategies used was considered entirely satisfactory. An alternative strategy was devised from a combination of aspects of the strategies trialed.

Arámbula-Greenfield, Teresa

Strand 10 — Sun, 23 Apr, 1995 8:30 AM California

Girls' and Boys' Use of Interactive Science Museums

This study examines the relative attraction of hands-on, interactive science museum exhibits for females and males. Studies have demonstrated that such exhibits can be effective learning experiences for children, with both academic and affective benefits. Other studies have shown that girls and boys do not always experience the same science-related educational opportunities and that, even when they do, they do not necessarily receive the same benefits from them; these early differences can lead to more serious educational and professional disparities later in life. As interactive museum exhibits represent a science experience that is readily available to both girls and boys, the question arose as to whether they were being utilized similarly by the two groups as well as by adult women and men. It was found that girls gravitated more to exhibits focusing on the human body and boys to those illustrating physical science principles. However, this was less true of children accompanied by adults (parents) and of the adults themselves, than it was of children on school field trips who roamed the museum more freely. Girls also were much more drawn to puzzle solving than boys and boys utilized computer games much more frequently than did girls.

Atwood, Ronald K.

Strand 1 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Effects of Instruction on Preservice Elementary Teachers' Conceptions of What Causes Night and Day and the Seasons

Virginia A. Atwood

The purpose of the study was to test the effectiveness of a set of instructional strategies for changing the alternative conceptions of what causes night and day on earth and what causes the seasons. The subjects were 51 preservice elementary teachers (students). Pretests and posttests were done through individual interviews. The assessments included tasks which required application of the target conceptions. Both the assessments and the instruction made extensive use of the same inexpensive models. Instruction was designed to be perceived by the students as intelligible, feasible and fruitful. Alternative conceptions identified most frequently on the pretest were confronted during instruction. All 15 students showing an alternative conception of what causes night and day on the pretest, provided a response which reflected a scientific conception on the posttest. Forty-one of 50 students showed evidence of making the desired conceptional change in their understanding of what causes the seasons from pretest to posttest.

Audet, Richard H.

Strand 2 — Mon, 24 Apr, 1995, 8:30 AM, Suite 2625

Learning Logs: A Tool for Supporting Communities of Scientific Sense-makers

Paul Hickman Gerald L. Abegg

This case study analyzed the impact on learning of a classroom practice that encourages class members to share thoughts and observations, to defend viewpoints and to negotiate consensus about their thinking. The activity that facilitates this sense-making process is computer-based, networked journaling. Because this type of dialogue format provides more than a context for simply organizing notes, observations and data, we call them "Learning Logs". Systematic analysis of the scientific conversations contained in Learning Logs shows that this discourse supports a dynamic environment that helps learners make sense of science topics. Writing in Learning Logs provides a vehicle for students and teachers to make their knowledge public and builds an atmosphere for valuing the conceptual understanding of others. The journals mediate a continuous dialogue between the instructor and students, a feature that reshapes traditional classroom roles and responsibilities. Conversing about science through the medium of computerized Learning Logs results in a community of reflective learners.

Ayala, Nancy

Strand 9 — Tue, 25 Apr, 1995, 1:00 PM, California

La Relacion Entre la Actividad Productiva y los Procesos de Pensamiento Implicados en la Solucion de Problemas

Esta investigación tiene por objeto identificar la relación entre la actividad productiva y los procesos de pensa miento implicados en la solución de problemas. Se tomó una muestra de 30 sujetos que recibían formación en el SENA (Servicio Nacional de Aprendizaje) de Cali-Colombia, teniendo en cuenta que el tipo de actividad en la cual se formaban fuese de caracter manual e intelectual. Entre los sujetos A.P.M. (ActividadProductiva Manual) y los A.P.I. (Actividad Productiva Intelectual) no se encontraron diferencias significativas en cuanto al proceso de solución de problemas excepto a la componente de regulación.

Backe, Kathrine A.

Strand 4 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

Using Video to Evoke Reflection on Science Teaching: BSCS Teacher Development Modules for Elementary School Science

James D. Ellis

With support from the National Science Foundation, BSCS is collaborating with science educators, science supervisors and science teachers to develop, evaluate, refine and disseminate four teacher development modules to support the improvement of science teaching in the elementary school. The modules develop major themes of the contemporary reform in science education—*innovative instruction* (contructivism, cooperative learning and learning styles), *curriculum emphases* (thematic, less-is-more, S/T/S), *equitable teaching* and *alternative assessment*. Subtopics include the nature of science and technology, major science concepts, interrelationships among science and mathematics, classroom management and educational technology. Each module consists of a printed learning guide supported by three video-discs of case studies of effective teaching and of interviews with outstanding teachers and their students. Although designed for use by teacher educators, experienced elementary teachers are the primary audience. Preservice teachers enrolled in methods courses also are potential users of the materials. The materials are being evaluated in both inservice and preservice settings.

Bailey, Bambi L.

Strand 4 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

Teachers' Perceptions of the Relative Importance of Science Methods Course Topics

William Letts Kathryn Scantlebury

Before change takes place in preservice secondary science methods courses, the relative importance of topics taught in those courses should be ascertained. Any changes in the importance of the topics must be addressed when attempting to redesign secondary science methods courses. The purpose of this survey was to provide information toward that end. Inservice teachers rated the relative importance of secondary methods course topics in a survey using a five point Likert scale. There were also open-ended questions probing for any topics not mentioned, any refinements to existing topics that might be necessary and valid evaluations and assessments. Means, standard deviations and percentages were calculated on the results of the survey for each of the eight units the 42 individual topics making up the units. Results indicate similarities among the priorities inservice teachers give to the topics covered in typical science methods courses. Teachers indicated a wide variety of valid assessments with particular emphasis on portfolio and performance based assessments.

Baker, Dale

Strand 6 — Tue, 25 Apr, 1995, 8:30 AM, Gold Rush B

Introduction to the Monograph "Gender Equity and Science Education"

Kathryn Scantlebury

The monograph, *Gender Equity and Science Education*, is discussed. It consists of scholarly papers that examine the issues of women in science from a variety of perspectives. The purposes of the monograph are to serve as a general reference for both seasoned researchers and advanced graduate students who wish to familiarize themselves with the wide range of equity issues in science education, as well as less traditional theories and research paradigms emerging from feminist scholarship. It also will serve as stimulus for teachers to examine their practice when used as part of the readings in courses and workshops. Monograph contributors will present this session.

Balling, John D.

Strand 10 — Sun, 23 Apr, 1995, 8:30 AM, California

The Effects of Pre-trip Programs on Learning from a Single-visit Zoo Field Trip

John H. Falk

The effectiveness of pre-trip programs for improving learning on single-visit field trips to a zoo was tested using 31 Grade four classrooms. Pre-visit program content and program instructor were manipulated in a 3 x 3 completely randomized factorial design, plus controls. The content areas were Cognitive, Orientation and Observational; the instructor variables were Zoo educator, classroom Teacher with Workshop experience or classroom Teacher with No Workshop experience. A pre- and two post-tests were given to assess learning in all domains. All groups taking the zoo trip demonstrated highly significant and persistent learning; the Orientation and Teacher with Workshop variables had the strongest impact on learning relative to controls. Results were interpreted in terms of the primacy of children's need to acquire information relative to their own learning agenda.

Barba, Robertta H.

Strand 1 — Mon, 24 Apr, 1995, 8:30 AM, Monterey

Children's Tacit and Explicit Understandings of Dinosaurs

The purpose of this cross-age study was to investigate elementary students (N = 120) tacit and explicit understandings of dinosaurs. Detailed analysis of audiotaped interviews of children's performance during a Piagetian-type clinical interview suggests that children's conceptual understandings of dinosaurs are first developed at a tacit level from their experiences with models, pictures, movies and concrete representations of ancient life, all of which are part of the milieu of childhood. Even though young children have difficulty verbalizing their conceptual understandings of ancient fauna, they are able to classify representations of fauna as being Mesozoic or non-Mesozoic species with high degrees of accuracy. As children mature and/or have more experiences with dinosaurs-related concepts, they are able to verbalize more geologic time related explanations of ancient life. Findings from this study tend to support Polyani's (Michael) Theory of Tacit Knowledge in that children's conceptual understandings are built first at a tacit level and later develop at an explicit level. Implications of assessment practices in elementary classrooms suggest a reconsideration of the reliance on instruments based on verbal performance.

Barden, Laura M.

Strand 7 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

Focusing Students' Attention to Videotaped Analogies Using Questions

William J. Kermis — William G. Holliday

Three experiments were conducted to determine the effects of questions embedded in science videotapes on high school students' attention to analogies. A videotape which included analogies to illustrate atomic processes was used for all three experiments. In Experiment 1, 34 subjects were assigned to one of two treatment groups (lower-order or higher-order question group). The subjects viewed the videotape and completed a free-verbal-recall (FVR) and cued-recall (CR) posttest on a single day. In Experiment 2, 316 subjects were assigned to one of four treatment groups (one of two lower-order or two higher-order question groups). On the first day of the experiment, subjects viewed the videotape with questions. The subjects completed unrelated activities on the next two consecutive days. On the fourth day, subjects completed the FVR and CR posttests. In Experiment 3, 18 subjects were assigned to one of two higher-order question treatment groups. On the day of the experiment, subjects viewed the videotape individually, responding to questions orally, then completed the FVR and CR posttests. The results of the three experiments suggested that the questions enhanced subjects' recall of question related information but not their recall of non-questioned information. This was particularly true for analogy-related questions.

Barnea, Nitza

Strand 4 — Sun, 23 Apr, 1995, 4:00 PM, Redwood

Model Perception Among Preservice and Inservice Chemistry Teachers

Yehudit J. Dori — M. Finegold

Not enough emphasis is put in science teaching on the fact that models are simulations of reality based on a certain theory and that molecules are not miniatures of the models that represent them. We investigated how Chemistry teachers perceive the nature and functions of models. The research population included two groups: an experimental group — inservice teachers who attended 56 hour training and a control group — pre and inservice teachers who did not receive the treatment. The training dealt with the model concept and ways to use various model types to illustrate chemical bonding and structure. Most of the participants from both groups thought of a model as a way to describe a process or a phenomenon which we cannot see. They perceived models as a means to enlarge or reduce the real process or phenomena, or to illustrate some theory. More teachers who took part in the training agreed that models can be used for prediction. Only the teachers of the experimental group made a distinction between a mental image and a concrete model that can be seen and touched. Overall, the inservice training on models has improved several aspects of the trainees' model perception.

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Barowy, William

Strand 4 — Sun, 23 Apr, 1995 8:30 AM Washington

Factors Influencing the Use of Internet Communities for Secondary Science Teacher Enhancement

Catalina Laserna Barry Saferstein

Community of Explorers is a three year NSF project studying a combination of collaboration strategies and technology as a model for science teacher professional development. We are using the Internet to create a community that supports teachers in exploring and reflecting on new approaches to teaching high school science. The curricular technology includes RelLab and Explorer modeling software, while the telecommunication technology includes client-server software such as Eudora and NCSA Mosaic. In contrast to using the network for dissemination, we focus on teacher activity and initiative through which teachers create curricular materials for exploration and discussion, while project personnel provide support for teacher exploration, reflective practice and innovation. We are applying a cognitive apprenticeship framework to help structure and facilitate interactions between participants with different expertise. We are investigating the factors that contribute to the long-term viability of this type of electronic network community for the professional development of high school science teachers. Because this model moves away from centralised dissemination to resources constructed by the participants and expertise drawn from within the community, it has the potential to scale to larger dimensions, thus for the use of telecommunications in wide-scale teacher professional development.

Barrera de Aragón, Maria

Strand 9 — Sat, 22 Apr, 1995 7:00 PM Suite 2601

Consecuencias Didacticas del Perfil Epistemologico del Concepto Cuerpo en la Obra Newtoniana

Generalmente los textos para los aprendices de física ignoran la génesis y por ende los perfiles epistemológicos de los conceptos, presentando en su defecto los conceptos y /o teorías físicas a modo de definición para que el estudiante los aprenda de modo memoristico y acritico. Investigando la génesis y el perfil epistemoliógico del concepto cuerpo para la física, historicamente nos ubicarnos en los "Principios Matemáticos de la Filosoffa Natural" de Isaac Newton. Si bien en los "Principia" encontramos el concepto en el ámbito del "Racionalismo Concreto" no debemos descronocer a Rene Decartes, quién desde la metafísica y el racionalismo purpo, es el precursor mas próximo a Newton. La investigación nos va demostrando el modo como el concepto cuerpo en la sociogénesis de la ciencia barrió un perfil epistemológico con una cierta semejanza al progreso que se sigue en la psicogénesis. Lo anterior nos sirve de base para la investigación sobre eluso, enseñanza y presentación del concepto en la epoca actual y detectar el proque de la persistencia de los obstáculos epistemológicos que se presentan para el aprendizaje del concepto; y la gran responsabilidad que tienen los textos de estudio que introducen a los aprendices en el apradigma de la memorización y ahistoricidad de la ciencia.

Barrow, Lloyd H.

Strand 10 — Sat, 22 Apr, 1995 8:30 PM Emerald

Attributes of Research Technology Proposals for Elementary Science

Coralee Smith Joe Curran

The purpose of this study was to analyze 37 research proposals to determine specific attributes. A scoring rubric was developed for the four major categories: hypothesis, shared vision (capability of including videodisc instruction with district's philosophy of teaching science), staff development and effectiveness of measurement. The categories were rated as being adequately addressed, partially addressed, or not addressed. It was concluded that overall, grant writers were not familiar enough with the components of a research design to write an effective proposal.

Bartley, Anthony W.

Strand 4 — Tue, 25 Apr, 1995 1:00 PM Washington

Portfolios for Preservice Teacher Education: Procedures and Promises

The use of portfolios in preservice teacher education, is a natural consequence of the move towards more authentic measures of student achievement in schools (Collins, 1992; Natzer, 1994). This paper describes the set of procedures developed for the implementation of portfolio assessment during the science methods course of a one-year teacher education program. Student teachers were asked to develop a portfolio with the goal of showing growth as a teacher of science in the elementary curriculum. I presented an analysis of the strengths and the potential pitfalls inherent in this mode of assessment and made recommendations about how such problems might be avoided. The portfolios show that these student teachers gained valuable opportunities to reflect upon their actions (Schön, 1983) and were able to examine their own growth as a teacher over a period of seven months, particularly in their confidence in teaching science. These claims are discussed in terms of the consequential validity (Messick, 1989) of the assessment program. The paper concludes with comments about the process from participating student teachers.

Baumert, Jürgen

Strand 6 — Mon, 24 Apr, 1995 2:30 PM Suite 2601

Gender, Science Interest, Teaching Strategies and Social Shared Beliefs about Gender Roles in Seventh Graders: A Multilevel Analysis

Interest in science steadily declines during junior and senior high school. The gender gap interest with the exception of biology increases during this period. The goal of this study is to see how much latitude teachers have to intervene in order to positively influence the development of interest and to reduce gender specific differences and which organizational steps and teaching strategies are suitable for reaching these goals. In a multi-level analysis the study shows great class differences, not only in the general interest development but also in the differential development of boys and girls. Five components of classroom organization, classroom climate and teaching strategies have been identified as being responsible for positive interest development.

Becker, Joe

Strand 2 — Sun, 23 Apr, 1995 10:30 AM Gold Rush A

Scientific Activity and the Two Ways of Knowing

Maria Varelas

In this paper we present a perspective on the nature of intellectual knowing central to the practice of science. The perspective allows us to see more deeply into contributions which two major developmental epistemologists, Piaget and Vygotsky, offer science educators. Our starting point is the distinction between two ways of knowing: empirical and conceptual. Essentially this distinction underlies the dialectic between theory and data at the center of the practice of science. The dialectic depends on holding as distinct knowing characterized as empirical (data) relative to some other knowing which in turn is characterized as relatively conceptual (theory). The theories of intellectual development of both Piaget and Vygotsky are also built around this same distinction. We will describe and elaborate on these two approaches to the differentiation and coordination of theory and data (conceptual knowing and empirical knowing) with a view to seeing what each contributes to a theory of the epistemological issues of science education and to develop for science educators a synthesis of the Piagetian emphasis on a primarily endogenous process of integration with the Vygotskian emphasis on the role of preexisting intellectual achievements.

Beeth, Michael

Strand 1 — Mon, 24 Apr, 1995 2:30 PM Oregon

Conceptual Change Learning: Some Theoretical and Pedagogical Issues

The purpose of this study was to determine how theoretical principles of the Conceptual Change Model translated into the pedagogical practices of one teacher. The researcher spent one year observing and interacting with the teacher and 13 Grade 5 students in this study. This teacher used her knowledge of historical and philosophical issues related to the science content to inform her personal view of student learning as well as her instruction. She facilitated conceptual change learning for her students by focusing their attention on the status of ideas at any point in time and also by challenging problematic components of the students' conceptual ecologies. Establishing the metacognitive ability to engage in discussions about the current status of an idea were a significant aspect of this teacher's instruction. However, once the ability to determine status was established, these students were then able to indicate which components of their thinking needed to change and for what reasons. Analysis of this teacher's instruction, in conjunction with other successful reports of conceptual change instruction, provides a framework for thinking about the role played by this teacher.

Bell, Philip

Strand 7 — Mon, 24 Apr, 1995 8:30 AM Portola

Electronic Discourse and the Integrated Learning of Science

Lydia Tien

Electronic discourse has many potential uses in the science classroom. This study investigates the use of electronic discourse between middle school students and graduate student researchers for scaffolding the students' integration of science knowledge. Comparisons are made to an analogous use of the technology in a college chemistry class. An analysis of the electronic exchanges revealed several recommendations for achieving integrative discourse in middle school classrooms: technical aspects of the communication should be minimized, time should be consistently allotted for the activity as part of the curriculum, responses to student messages should be prompt, and participants should learn that the inherent constraints of electronic communication call upon them to be more clear and precise in their messages.

Belzer, Sharolyn J.

Strand 7 — Sun, 23 Apr, 1995 8:30 AM Emerald

A Conceptual Change Rationale for the Design of BioMap: An Interactive Hypermedia Environment to Promote Conceptual Understanding of Biological Evolution

BioMap represents an innovative instructional application, designed to address educational as well as scientific concerns about how we, as educators, can better teach evolution to non-science majors. BioMap was designed to meet the criteria for conceptual change while providing necessary scaffolding to direct student thinking, provide support and a manageable level of complexity. A study with undergraduate non-science majors will attempt to optimise student learning by: (1) encouraging students to use BioMap more interactively, and (2) administering strategy and content surveys periodically so that students reconsider what and how they are learning. One goal is to facilitate the learning of biology, to characterise and reduce common misconceptions, specially those related to evolution and natural selection. Other goals of the study are to assess student strategy use within BioMap and to determine the demographic, academic, conceptual and strategy-oriented parameters that are predictive of the learning and achievement of content, as measured by pre-to-post-test differences and final post-test scored respectively. A final goal in the study is to assess the effectiveness of BioMap materials that were developed based upon current research on undergraduate learning and conceptual change.

Ben-Chaim, David

Strand 1 — Tue, 25 Apr, 1995, 8:30 AM, Washington

Examination-type Preferences of College Science Students and Their Faculty in Israel and USA: A Comparative Study

Uri Zoller Steven D. Kamm

The science-examination preferences of college science students and their science faculty were surveyed, using the TOPE questionnaire at teacher training and community colleges in Israel and the US respectively. The results obtained in the two countries were compared, in total and by gender, in terms of significant/no significant differences in the preferences made and the reasons provided by the students and faculty for their ranking. Our findings suggest that: (1) college science students prefer mostly, the Israelis more so than the Americans, the nonconventional, written exams in which time is unlimited and any materials are allowed, (2) American college science students prefer the traditional class science examination significantly more than their Israeli counterparts, (3) the preference of HOCS-oriented exams is significantly higher for female science students in Israel compared with no gender difference concerning the preferred examinations in the US and rejection of oral exams by all in both countries and, (4) there exists a significant gap between the preferred type of examinations of science students and their faculty in both countries. In view of the HOCS-orientation and the goal of conceptual understanding in current reforms of science education worldwide, the consonance between these curriculum objectives and examination practices is advocated.

Berg, Craig A.

Strand 2 — Sun, 23 Apr, 1995, 1:00 PM, Nevada

One Computer Per Small Group Versus One Computer Per Class: How Two Different Formats Affect the Quality and Quantity of Student-Student Interactions While Using a Computer Simulation

Joy Brandstrom Joe Sutter

Computer software utilized with appropriate learning strategies can assist teachers in developing powerful learning environments by dramatically increasing the quality and quantity of student-student interaction. During simulations, cooperative small groups cycle through one computer, then break away to dialogue and process the information collected. This forced and cyclical break from testing appears to be an important factor in promoting student-student interactions and other desired outcomes related to socially constructed knowledge. This study examines the question "How would student-student interactions be affected by providing each small group with a computer, thereby eliminating the forced break? Two classes of students: one with a single computer, and one with a computer for each small group, used the simulation for three days. Videotape was used to analyze the quality and quantity of student-student interactions. The results indicated large numbers of interactions for both groups, yet individual participation was more equally dispersed in the one-computer class, and their interactions tended to be at a higher cognitive level. An initial analysis of a second study involving middle school students suggests somewhat similar outcomes to the first study.

Berger, Carl

Strand 7 — Tue, 25 Apr, 1995, 2:30 PM, Portola

Students' Use of Multimedia Science Instruction: The MTV Generation?

Trisha Jones Charles Dershimer

The purpose of this study was to analyse students use of a microcomputer supported chemistry instructional program. A multimedia interactive software package was used as the learning environment. The package contained screens of information in text and picture form, animation, simulation, video segments, focus questions, inquiry questions and an organising concept map. Students could navigate by clicking on icons that initiated the next event or state of learning. Data were gathered automatically in log files. Data ranged from 6 to 551 events for the 91 students having from one to four experiences with the program. Students spent from 2 to 326 minutes (over eight hours) on the materials. Results indicated that students varied widely in using the materials and spent on the average less than a minute on each event. Cluster and factor analysis indicated that there were three distinct different profiles for students based on the percent time per event spent on each kind of activity and that students responded to questioning prompts more than any other technique. Teachers using multimedia may falsely claim that the short amount of time spent on events inhibits learning but evidence for this hypothesis was not supported.

Berlin, Donna F.

Strand 5 — Mon, 24 Apr, 1995, 2:30 PM, Portola

Integrated Science and Mathematics Assessment: Multiple Approaches to Identifying and Analyzing Student Outcomes in Different Cultural Settings

John J. Smith

This study is part of a three-part project designed to explore the nature of student outcomes related to participation in integrated science and mathematics activities in different cultural settings. Four teachers in grades four, five and six observed their students during integrated activities and recorded student outcomes and evidence in Classroom Observation Journals. The purpose of this paper is to combine the information gathered from the practitioners with the analyses provided by two independent, external researchers. Each researcher was instructed to code, sort and classify the outcomes from the four sites, identified only by number. As the researchers employed different approaches and identified different categories, we focused on the aggregate of their findings. Additional analyses, combing data from the two Anglo sites and from the two Hispanic-American sites, were also conducted. For both researchers, a significant category and ethnicity by category difference was revealed. Generally, lower level cognitive, affective and process skills were most often recognized by the practitioners. Outcomes are further discussed in terms of the specific categories identified by each researcher. These results will serve as the starting point in the development of an integrated science and mathematics assessment package that is culturally sensitive and responsive.

Bernhardt, Elizabeth

Strand 6 — Tue, 25 Apr, 1995, 8:30 AM, Suite 2601

A Content Analysis of Science Methods Texts: What are we Told about the Bilingual Learner?

The purpose of this paper is to obtain a picture of how science teachers seem to be directed to accommodate the bilingual child in their classrooms. In order to address the purpose, a representative sample of science methods textbooks that have appeared since 1980 were examined (N = 25). In addition, journals such as *Journal of Research in Science Teaching*, *School Science Review*, *The Science Teacher*, and *Science Education* among others (N = 12) were surveyed in order to come to an additional understanding of what approaches and knowledge science teachers have been encouraged to use by their profession. Results reveal a rather bleak picture. While there is some mention of the concept of "multiculturalism", there is little if any awareness of the particular circumstances of bilingualism. Instructional strategies, explanations of the sociology of bilingual learners, and information about research in second language content learning clearly need to be infused into the science teacher education pre and inservice curriculum.

Bianchini, Julie A.

Strand 2 — Sun, 23 Apr, 1995, 1:00 PM, Nevada

How Do Middle School Students Learn Science? An Analysis of Scientific Content and Social Processes in Cooperative Groups

Precisely how do students working in groups learn science? What processes do they use to negotiate and construct scientific knowledge? Are some denied access to their group's materials and discourse? In this dissertation study, I examine how the following three factors facilitate and constrain students' participation in groupwork and thus, their learning of science: (1) unique features of the curriculum materials and instructional approach, (2) differences in student gender, ethnicity, previous academic achievement, and status (perceived academic achievement and popularity) and, (3) patterns of teacher talk. Research for this study was conducted over the course of two science units in three class periods of one middle school science teacher. Data were collected using quantitative observation instruments, audio and video tapes, and paper-and-pencil unit tests. Significant differences were found in rate of student talk in groups and in performance on science unit tests. Extensive analysis of students working in groups offers possible explanations for these differences as well as insights into how students construct or misconstruct their understandings of science.

Black, Kathie M.

Strand 4 — Sun, 23 Apr, 1995, 10:30 AM, Monterey

Improved Science Content for Preservice Teachers: Modelling of Teaching Strategies Based on Current Science Education Reform Literature Part II — A Comparison of Three University Elementary Science Programs

The purpose of this study was to evaluate different approaches to preservice science teacher education programs as to their effectiveness in preparing teachers to teach science. Of particular interest was the comparison of outcomes resulting from three various teaching methodologies of science as to general science knowledge, attitudes toward science, reasoning patterns and problem solving skills and opinions towards importance and future usage of teaching strategies. Instruments utilized were: a demographic survey; the NTE science knowledge test; the International Science Study Survey on Science Attitudes; Teaching Strategies Survey and, Reasoning Patterns test. Results for students in the treatment group (see Part 1, Black, 94) were compared against results for students in two separate control groups. It was found that the treatment provided resulted in students from the experimental group having significantly higher positive science attitudes, stronger awareness of the teaching learning process and higher ratings of future usage of computers in the classroom than students in each of the other control groups.

Black, Paul

Strand 5 — Sun, 23 Apr, 1995, 1:00 PM, Redwood

Teachers' Assessments and Pupils' Self-assessment in Great Britain

Attempts to work with a group of schools in the UK seemed to lead the involved teachers to gravitate towards development of self-assessment by pupils. The superficial reason for this is that if pupils can identify needs for themselves, then formative assessment in the classroom may be more manageable. The deeper reason may be that close guidance through frequent feedback to pupils becomes intolerable unless they are partners rather than serfs. The paper will describe some experiences, in three schools, of different approaches to involving pupils. The outstanding feature is that the enterprise exposes, as a necessary condition, the need for pupils to understand the aims of their learning. This is surprisingly hard to achieve, partly because of the need to establish a new type of communication, but also because for pupils it involves a change in their perception of their part in the learning system. The emphasis is therefore shifted onto the need to help develop pupils' capacity to learn for themselves. Teachers find it hard to devote the time needed for such an aim to make headway; here other experience, notably of the Melbourne-based PEEL project, is relevant. One question for consideration is whether pupils' self assessment is an important, perhaps even an essential, component of any strategy for developing effective formative assessment.

Bleicher, Robert E.

Strand 3 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

Conceptual Change Based on Laboratory Experience

The purpose of this study was to examine the activities and discourse between scientists and high school student apprentices in research laboratories and how these supported and/or constrained student learning of science. The study covered three consecutive years of a summer science program and included 32 participants. Data were collected and analyzed within a multiple perspective research design composed of microethnography and interactional sociolinguistics. Student apprentices made noticeable gains in conceptual understanding of science as well as gaining new insights into the world of the scientist. Program experiences carried over positively into the classroom in the school year following the program. Results suggest that a cognitive apprenticeship model of science learning would be worthwhile pursuit in school science instructional settings.

Bloom, Jeff

Strand 1 — Mon, 24 Apr, 1995, 8:30 AM, Oregon

The Development of Children's Discourse During a Unit on Buoyancy

This study examines the development of grade 6 - 8 children's discourse during a unit on buoyancy and its relationship to conceptual understanding. The theoretical framework guiding this examination is based on recent research into student discourse. Morrison, Newman, Crowder, and Théberge (1994, April) have adapted Kuhn's (1989) framework for analyzing student scientific discourse. Analysis of conceptual development is based on Keil's (1989) delineation of conceptual structure on on contexts of meaning (Bloom, 1992a; 1992b). the combination of these two theoretical frameworks provides an inclusive means for analyzing the kinds of information generated by the students, and also provides a basis for assessing and addressing student ideas, as well as for designing and implementing instructional activities.

Bodner, George

Strand 10 — Tue, 25 Apr, 1995, 1:00 PM, Redwood

A Critical Examination of Relevance in Science Education Research

Dan MacIsaac

In this theoretical paper, the questions of relevance and accountability in science education research are first reviewed and then addressed via comparison of the two most prevalent research methodologies: causal empirical-analytic and naturalistic-hermeneutic. Critical theory and action research are proposed as alternative paradigms. A study planned in the Chemistry department of a midsized Midwestern university is discussed in terms of the three interpretations.

Bolte, Claus

Strand 2 — Mon, 24 Apr, 1995, 10:30 AM, Nevada

How to Gain an Insight into Special Aspects of Chemistry Instruction

We began our research with two hypotheses. First: one of the main determinants of the success of chemistry instruction lies in the behavior of the lessons' participants. Second: someone, who is interested in the quality of chemistry instruction, needs "objective information" about the kind and manner of the interactions during the lessons. On the basis of these hypotheses we have developed a special computer-assisted categorically-structured system for systematic observations of chemistry classes. Using this instrument 45 lessons of preservice and inservice teachers were coded both from videotapes or from live-sessions. With the help of the instrument it was possible to evaluate the effectiveness of classroom management (and its consequences) in a very economical manner. The results of the data analyses showed that teachers, as well as researchers, can gain insight into special aspects of chemistry instruction. The assessment of direct supervision turned out to be very rewarding for everyone involved in teacher training programs. Knowledge concerning the student and teacher interactions makes it possible to effectively improve teaching practice.

Bombaugh, Ruth

Strand 2 — Tue, 25 Apr, 1995, 1:00 PM, Emerald

Space and Time: An Ontological Analysis of Contextualized Relations between Subjects and Objects in an Eighth-grade Science Classroom

Crowdedness is used as a unifying theme to demonstrate power structures and role definitions in this ontological analysis of an eighth-grade science classroom. Examining the setting, both space and time reveals how the background situates both the at-risk students and their 20-year-veteran male teacher in daily interactions with each other and the objects of their world. Careful analysis suggests that the background details which are placed in relief and highlighted — room architecture, distribution of resources, tactical use of objects and allocation of space and time — all fit into a traditional pattern of an hierarchical educational setting with modern accoutrements.

Bonilla, Pablo A.

Strand 9 — Sun, 23 Apr, 1995, 2:45 PM, Suite 2625

Las Nociones de lo Vivo y lo No Vivo en Ninos de Primero de Primaria

NormaC. Castaño Julio Munevar Aura Burgos

Para evidenciar la noción de vivo y no vivo se trabajó con 59 niños de primer grado de primaria a quienes se les presentarondoce objetos los cuales debían colarear, darles un nombre yclasificarlos en vivos y no vivos. Se encontró que el 30% de los niños no presentarondificultades en la clasificación. Pero en el 70% seevidenciaron probelmas relacionados con la distinción entrelos objetos no vivos con movimiento propio y los vivos, mostrando una concepción animista de lo vivo, tal como loafirma J. Piaget. Es notorio que para un 15% de los niños las plantas no seconsideran en el grupo de los seres vivos. Existe cierta ambivalencia en aproximadamente el 5% en las respuestas en el momento de decidir. Se alude a que aún en estos primeros niveles de educación se empiezan a lacer notorios los preconceptos influenciados no solo por la escuela, sino también por los medios de comunicación.

Boone, William J.

Strand 5 — Sun, 23 Apr, 1995, 8:30 AM, Suite 2625

Undergraduate Non-Science Majors' Evaluations of Geology Labs

At a large state university over 150 non-science majors rated 13 geology labs using 10 rating criteria. The data were evaluated using a multifaceted item response theory model to determine those labs which were viewed as being the best as defined by the rating criteria. Students felt that labs involving the geology around campus, and evaluation geology fossil record were quite good. Labs that were not highly rated were ones involving acid mine waters, fossils and density driven circulation. In general all of the labs were viewed as having successfully supplied written and verbal directions. However, when students were asked whether or not the labs would help them in their future career, understand the world around them, or help them understand lectures, they were much less assured. This paper provides information for those guiding earth science classes, as well as those interested in improving the lab experience of non-science majors.

Borun, Minda

Strand 10 — Sun, 23 Apr, 1995, 2:45 PM, Gold Rush A

Naive Knowledge and the Design of Science Museum Exhibits

Christine Massey Tilu Lutter

The Naive Knowledge Study at the Franklin Institute Science Museum in Philadelphia, PA, took place over a three and one-half year period ending in April, 1992. It was both a research and application project to uncover widespread misconceptions about the concept of gravity held by museum visitors and to test the efficacy of hands-on exhibits in altering these naive notions. Exhibits were designed to counter typical and persistent misconceptions and enable visitors to shift from the naive knowledge of the "novice" to the more sophisticated understanding of the science "expert". The study revealed that hands-on exhibits with carefully worded labels, can indeed alter naive notions and open the door to new understanding.

BouJaoude, Saouma

Strand 10 — Mon, 24 Apr, 1995, 8:30 AM, California

Lebanese Middle School Students' Definitions of Science and Perceptions of its Purpose and Usage

Fouad Abd El Khalick

The purpose of this research study was to answer the following questions: (1) How do middle school students define science? (2) What is the purpose of science according to middle school students? (3) Where and how do middle school students see themselves using science? (4) Where do middle school students see others using science? (5) What are the perceptions of middle school students of how others use science? (6) How do the science teachers perceive the purpose of science and students use of science? Eighty middle school students from four schools in Beirut, Lebanon participated in this study. Results show that middle school students in Lebanon have a restricted view of science. Most of them defined science as an academic subject, perceived its purpose as preparation for higher grades and studies and saw themselves and others using science in academic settings. Moreover, the teachers interviewed in this study showed similar perceptions to those of their students. It does not seem that Lebanese students are aware of the importance of science in everyday life.

Bowen, Craig

Strand 4 — Sun, 23 Apr, 1995, 1:00 PM, California

Evaluating Inservice Science Teacher Education Programs: A Case Study

This paper describes a case study of an evaluation conducted on two inservice education projects for high school Chemistry teachers. The purpose of the study is to offer a model for designing evaluation procedures of inservice projects that takes into account theories of attitude as they relate to teacher change. The paper begins by reviewing theories of attitude and then relating them to models of staff development. A review is given that examines the evaluation practices associated with determining the effectiveness of teacher inservice programs. After the literature review, the case impact study include survey, interview and observational data from a sample of the participating teachers and their students. Data analysis focuses on the developmental nature of the change processes for the teachers. Finally, the paper ends by offering suggestions for designing evaluations for inservice teacher education efforts.

Breen, Timothy J.

Strand 5 — Sun, 23 Apr, 1995 4:00 PM Oregon

Thinking and Reasoning on Statewide Science Assessments: Examples from Performance-based Assessments in California

Gail P. Baxter Robert Glaser

Researchers from the University of Michigan and the University of Pittsburgh, together with the California Learning Assessment System (CLAS), gathered evidence to support inferences that optimal performance on CLAS science assessments requires high levels of thinking and reasoning. Grades 5 and 8 students were interviewed while carrying out the CLAS 1993 science performance assessments. Interview protocol analysis in conjunction with observations of students' performances and an examination of students' answer booklets and scoring criteria provide an empirical basis for linking performance scores with level and kind of reasoning and understanding. If the assessment task requires students to engage in higher-order thinking, then students who score high should exhibit some characteristics of proficient performance (ability to plan reason, explain, draw inferences, systematically solve problems and monitor their own performance). In the analysis two aspects were examined: (1) whether the task offered students opportunities to engage in higher-order thinking and, (2) whether the scoring system was able to capture and reflect differential performance. The results provide insights into the critical features of tasks and scoring systems that ensure appropriate cognitive skills are engaged by tasks and that scoring criteria are linked to task demands.

Briscoe, Carol

Strand 4 — Sun, 23 Apr, 1995 10:30 AM Monterey

An Inservice Program Focusing on Collaboration to Facilitate Change in Elementary Science Teaching

Joseph Peters

This study describes an inservice project for elementary teachers that assisted teachers to implement a curriculum emphasizing hands-on, problem-centered learning in science. The project plan was based on three theoretical perspectives: (1) constructivism, (2) social and cultural aspects of meaning making, and (3) reflective practice. As teachers participated in the workshop and semester-long follow up activities, data were collected in the form of transcripts of meetings, lessons plans and field notes from classroom observations. Interpretations of the data, reflected in collaboration created an environment that supported learning and change. Implications relate the features of this staff development project that promoted the creation of the network and supported teachers as they implemented changes in their science curriculum.

Brody, Michael

Strand 10 — Tue, 25 Apr, 1995 8:30 AM Monterey

Ecology and Environmental Science Education: A Research Agenda, Year III

This session is a follow-up to the first roundtable discussion of this topic at the 1993-94 NARST Annual Meeting. At those meetings, a number of interested science educators met to discuss the role of ecology in science education research. The sessions generated many relevant questions regarding the role of ecology in the science education agenda. Among these questions were: As the natural resource management policies in the USA and the world evolve, what is the role of science education in educating students to understand a new ecological agenda? What research is necessary to help prepare teachers to respond to an increasing number of complex ecological issues? Is the nature of knowledge in ecology and environmental science inherently different than traditional science disciplines? Among the topics to be discussed this year are: substantive differences between educating about the environment compared to traditional disciplines in science education, the role of values and beliefs concerning the environment in science education and the role of gender issues related to environmental education in the science classroom.

Brown, David

Strand 1 — Mon, 24 Apr, 1995 2:30 PM Oregon

Theories in Pieces? The Nature of Students' Conceptions and Current Issues in Science Education

Increasingly, the need for clarity in discussing students' conceptions is being recognized as critical, since different perspectives can have different and even opposing theoretical and instructional implications. The purpose of this paper is to discuss a framework for interpreting students' conceptions and to illustrate its usefulness in clarifying issues. This paper will discuss several case studies of students' conceptions and learning in electricity and mechanics making use of the framework for interpreting students' conceptions. These case studies will then be used to help address issues such as the following: can students' conceptions be considered to be in some ways equivalent in form and/or content to theories in science? Can students' prior knowledge be considered in equivalent ways across domains, or do students' conceptions in different domains differ in important ways? Should instruction be designed to help students change their conceptions to widely accepted views, or should instruction be designed to help students grapple with phenomena and ideas, emerging with more clearly articulated ideas, albeit still somewhat idiosyncratic? If the goal of instruction is conceptual change, what instructional approaches will prove most effective? The purpose of the discussion will not be to provide answers to these issues, but rather to illustrate how a framework such as this can raise discussion of these central issues to a higher level.

Brown, Fletcher

Strand 6 — Mon, 24 Apr, 1995, 8:30 AM, Suite 2601

The Effect of Inquiry Instruction on Undergraduate Biology Students' Perceptions of Their Science Laboratory Learning Environment

In this study students in two different science laboratory learning environments were assessed using the Science Laboratory Environment Inventory (SLEI) to further understand the effects of inquiry and traditional classroom environments on students' perceptions of classroom learning. Results from this study suggest that an open-ended, inquiry laboratory had a positive effect on students' perceptions of their preferred classroom environment. In comparison to student responses in a traditional science laboratory classroom after exposure to an inquiry laboratory environment for one semester, students preferred more open-ended experimentation, cohesiveness among students, integration between lecture and lab and also preferred more adequate materials and equipment to use in the laboratory. These results have important implications when one considers the association of cognitive and attitudinal outcomes with the dimensions measured by the SLEI questionnaire. Results also indicated that a traditional science classroom does not effect students' preferences about the laboratory learning environment. Accompanying this analysis is a brief discussion of the profiles characterizing the two laboratory environments measured and a comparison of these profiles to the topology for science laboratory classes recently developed by McRobbie and Fraser.

Brown, Sally

Strand 5 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

Teachers' Thinking about Classroom Teaching: Resistance to the Concepts of a "National Curriculum" in Environmental Studies/Science.

The national curriculum in Scotland, the 5-14 Program, has offered teachers an apparently logical framework of concepts that is intended to bring about a number of changes in teaching and in the judgments that are made about students' attainments. Efforts have focused on introducing the curriculum in a way that is acceptable to teachers. This session reports on research into the extent to which the ideas of the curriculum have had an impact on teachers' thinking about their classroom teaching and their students' learning in environmental studies/science. The impact has been slight. Explanations for this point to: the complexity of the conceptual framework and how this is unsuitable for the immediacy and spontaneity of the science classroom; the ingenuity of teachers in using superficial characteristics of the concepts while retaining their traditional conceptual schemes and thought patterns; and (ironically) the way in which the efforts to ensure acceptability have discouraged change.

Browne, Ron

Strand 7 — Sun, 23 Apr, 1995, 7:00 PM, Exploratorium

Ohio's Classroom of the Future and its Effects on Students' Science Efficacy

This study examined the effects of Ohio's Classroom of the Future program on students' sense of efficacy in science and computers. A survey adapted from the Minnesota Computer Awareness and Literacy Assessment was administered by the researcher to 744 fifth through ninth grade students from eight Ohio school districts. Four of these districts were participating in the Classroom of the Future program while the other districts were chosen for their similarity in geographic location, socioeconomic characteristics and size. Using a t-Test, the data were analyzed using Classroom of the Future/Non Classroom of the Future district pairs, gender and grade level. Results indicate that regardless of the nature of the Classroom of the Future program developed, students in Classroom of the Future schools had higher science efficacy scores. Additionally, enrolment records of the participating school districts indicate that Classroom of the Future schools have higher percentages of students enrolling in elective science courses. Results for females were stronger than those for males.

Bullock, Linda D.

Strand 6 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

GEESE: Gender and Ethnic Equity in Science Education

The purpose of this training program is to provide preservice science teachers with the opportunity to use clinical observations and reflection as vehicles for discovery of the disparate school experiences of the diverse students in their science classrooms. The preservice teachers examine curricular materials in use during this practicum, student and teacher behaviors, the quantity and quality of student-teacher interactions and grouping and evaluative strategies before attempting self-analysis at the conclusion of the program. The program is conducted during the preservice teachers' practicum; interviews are used as the source of qualitative evidence of change in the preservice teachers' attitudes and behaviors. Students in the pilot program described the program as not simply important, but imperative for teachers beginning their professional careers.

Bunderson, Eileen D.

Strand 6 — Sun, 23 Apr, 1995, 8:30 AM, Suite 2601

Attitudes of Junior and Senior High School Students toward Science and Math

Much work has been done over past years to improve attitudes of K-12 students toward science. The bulk of intervention programs has occurred during the elementary grades. The purpose of this paper was to assess current attitudes of junior and senior high school students in two urban school districts and to determine if these attitudes remained stable from seventh through twelfth grade. Attitudes toward science were measured using an instrument developed by the author and administered to approximately 1200 junior and senior high school students. Responses were categorized using a 5-item Likert scale ranging from Strongly Agree to Strongly Disagree. Attitudes toward science remained similar to those previously reported in the literature. However, attitudes became progressively more positive for males and more negative for females as they moved toward grade twelve. Attitudes were also course dependent. Few students thought science was important to their daily lives and even fewer thought their parents would want them to be scientists. Confidence in ability to do and understanding science increased for males and decreased for females from seventh to twelfth grade.

Burger, Nikki

Strand 7 | Tue, 25 Apr, 1995 8:30 AM Portola

Teachers' Perceptions of the Use and Effect of Telecommunications in Teaching and Learning in Three Middle Schools

Pierce Farragher

The purpose of this study was to evaluate teachers' perceptions of the uses and effects of telecommunications on teaching and learning at three rural middle schools on Vancouver Island, British Columbia. Teachers play a vital role in how successfully a new technology will be implemented. The study used both qualitative and quantitative research techniques. Teachers from three rural middle schools completed a 21 item Likert scale measuring their perceptions, needs and experience of telecommunications. Structured interviews were also conducted with active users and non-users of the telecommunications system at the three schools. The interviews were taped and transcribed and focused on teachers' beliefs and background variables, the relationship between telecommunications and the curriculum, factors influencing teachers' decisions to use telecommunications, perceptions of how student-teacher roles, teaching style and the classroom culture might change and expectations for the future.

Burke, Christopher

Strand 1 | Sun, 23 Apr, 1995 8:30 AM Redwood

Framework of Student Conceptions Concerning Gravity

Rene Stofflett

The purpose of this study was to develop a framework for looking at students' conceptions concerning gravity. This provides a groundwork for understanding how these conceptions developed and how to avoid instruction that reinforces or causes alternative conceptions to develop. The data were gathered to this paper through two clinical interviews. There were 16 middle school students from rural Central and Southern Illinois. The study identified student conceptions concerning the location of gravity, the cause of gravity and the direction of force in a zero gravity environment. For each of these areas four general models were identified: scientific, partially scientific, naive scientific and gravity. The models that were identified are a framework of conceptions to help develop and how they use these conceptions to make sense of the world.

Burry-Stock, Judith A.

Strand 3 | Sun, 23 Apr, 1995 10:30 AM Washington

Expert Science Teaching: Expert Science Teaching Educational Evaluation Model (ESTEEM)

The Expert Science Teaching Educational Evaluation Model (ESTEEM) was developed to evaluate expert science teaching according to a combination of a constructivist and expert teaching philosophy. This perspective provides a sound theoretical basis for teaching and learning behaviours focusing on student-centered teaching that promotes meaningful, conceptual learning. ESTEEM is a professional development model to be administered by oneself, a peer, or an external evaluator. It houses five instruments designed to assess expert science teaching for both teaching practices and student outcomes and is currently being used for evaluating expert science teaching in many national projects.

Butler Kahle, Jane

Strand 4 | Mon, 24 Apr, 1995 10:30 AM Washington

Reforming Science Teaching: A Case Study of Changes

Anita Roychoudhury

In this paper we describe the teaching of a teacher who participated in a statewide systemic reform initiative to understand how teacher learning is translated in classroom practice. A case was constructed from the various data sources about the changes taking place in a Grade 9 Physical Science classroom as a result of the teacher's interest in the active involvement of students in learning. After participation in a university project aimed at science education reform, her pedagogical approach, formerly guided by a technical interest, changed to the one guided by a practical interest. She began to pay attention to the process of her teaching, not only to the product students were generating. She has been able to overcome several constraints, that often teachers blame for hindering inquiry-based teaching. Also she has modified her assessment to a certain extent to fit the new pedagogical attempts. The most significant aspect of this change is that the teacher views this as a process not a product she obtained from the experts at the university. The changes in her classroom continue according to her deliberation and self-evaluation.

Butts, David P.

Strand 5 — Sun, 23 Apr, 1995 4:00 PM California

Does a Summer Research Experience Make a Difference? An Application of the PACE Model to the ASCB Summer Research Fellows Program

Robert Bloodgood

The summer research fellowship program of the American Society for Cell Biology is a program which is designed to impact science teachers in a manner that will result in better science experiences for their students. The PACE model was used to evaluate the difference this program made with the 26 secondary science teachers involved for the eight week research experiences during the summers of 1992, 1993 and 1994. The data are teachers' descriptions of what they expected from the program before their summer experience, what they valued about their summer experience, what they intended to change in the science experiences of their students and what changes they were actually able to implement. By the end of their summer experience, they gained new insights into what science really was, a renewal of their excitement about science and a confidence that they could do "real science" in their classrooms with their students. While getting excited about doing something unique —something that is not found in the textbook, teachers believed that their experience increased their personal enthusiasm for science which they hoped they could pass on to their students during the school year.

Cabrera-Castro, Maria F.

Strand 9 — Sat, 22 Apr, 1995 7:00 PM Suite 2601

La Ensenanza de la Fisica en la Formacion de Profesionales en Docencia de la Biologia

Constanza Castaño-Cuellar

Los programas para las formación de profesionales en docencia de la Biología han intentado en todos los ámbitos universitarios Colombianos reformas que sólo han llegado a un modelo administrativo y ha desarrollarse ha titulo, pero su didáctica, su pedagogía y su enseñanza son elementos que poco se han trabajado como modelo universalizador de contenidos y de experiencia. Existen diversos factores por los cuales se encuentran francas barrreras en al abordaje de otros campos en la docencia de la ciencia Biológica, prima el interés por el desarrollo investigativo científico de lo celular, lo evolutivo, lo genético; más mo el establecimiento didáctico y de enseñanza de estos contenidos. Se trabaja la enseñanza de la Biología sólo desde modelos inductivos y deductivos como procedimientos didácticos, reduciendo la requeza de contenidos y especialmente de modelos alli presentes. Para el caso especifico de campos como el de la ciencia Fisica encontramos más demarcada la situación, pues no hay interés en el contenido físico, sólo en su memoria, sus métodos sólo son considerados en la forma más simple, lo que debilita completamente las bases sobre las que se estructura la ciencia Biológica.

Caggiano, Mary E.

Strand 7 — Sat, 22 Apr, 1995 8:30 PM Emerald

A Pilot Study of an Electronic Community of Interdisciplinary Secondary Science Teachers

R. Audet Gerald L. Abegg

The focus of this preliminary study is to understand the development and conditions necessary for supporting a professional community as a group of interdisciplinary science teachers come together through a telecommunications network. Although there are several types of electronic networks, limited research about networked electronic teacher communities exists. This study is investigating the conditions necessary for developing and sustaining teacher professional development by documentating patterns of teacher participation and changes (frequency and type of use) in utilizing email, bulletin boards, teleconferencing and software sharing. The high school science teachers from this study spent a minimum of two hours per week becoming acquainted with a commercial telecommunications system for one month prior to a summer institute and continue to interact with one another as they begin their school year. Interactions online have been co-ordinated, collected and supported by the community's facilitator. Pre-workshop electronic activities included several tasks to assist teacher familiarity with the network, public bulletin board sections for socialising, sharing resources and obtaining information about the workshop. Post-workshop (1-2 months after) public interactions have been initiated by the teachers and coordinated by the facilitator and other workshop staff to include professional support for: resources for classroom maintenance, new classroom strategies and opportunities for sharing teacher resources. These preliminary results indicate the potential for developing a collaborative community of professional practitioners.

Camacho, Moisés

Strand 1 — Tue, 25 Apr, 1995 1:00 PM Portola

The Effect of Mastery Learning Strategy on the Achievement of Science Students in College Chemistry

About 200 students of General, Organic and Analytical Chemistry were exposed to the Mastery Learning Strategy. The nature of the strategy was explained orally and by writing to all the experimental groups (11). Then the groups were allowed to vote for one of these general methods: (1) traditional lecture, (2) mastery learning. The majority of all the groups voted for the active strategy (90% - 100%). Until now 60%- 96% of all the groups approved the course (e.g. General, Organic or Analytical Chemistry) with "C" or better. In some groups, 70.0% of the students approved the course with a B or an A. Behavior and active participation (90%-100%) also improved, compared to the traditional groups, in which real participation (10%-20%) and achievement are very low. The experimental groups demonstrated an excellent behavior and positive attitudes toward chemistry.

Campbell, James R.

Strand 6 — Sun, 23 Apr, 1995 1:00 PM Oregon

Differential Socialization in a Multicultural Setting Affects Academic Achievement

Michael Kyriacou Koutsoulis

The objectives of this study were to determine the linkages among specific academic self-concepts (math, science, English, social studies) effort attributions, aspirations, attitudes toward school and academic achievement for 297 high school students in multicultural setting. The results of this study included the following findings: All path models explain substantial amounts of achievement variance. The strongest predictor of achievement for all models is the GPA (prior ability). The specific academic self-concepts are significant predictors of achievement (all subjects). SES influences achievement indirectly by influencing intervening factors. The study uncovered several differential socialization findings: Boys' science achievement is influenced by indirect SES connections, where girls' science achievement is influenced by their attitudes toward school. Girls' GPA's have more of an effect on their science achievement whereas boys GPA's have more of an effect on their math achievement. Girls' math self-concepts are more important to their math achievement and boys' science self-concepts are more important to their science achievement

Carnes, Nathan

Strand 10 — Sun, 23 Apr, 1995 8:30 AM Emerald

The Use of the Learner Profile in Observing Middle School Teachers Implementing Inquiry: Teaching Methods

Microcomputer technology became firmly established in the early 1970's. Since the advent of this technology, its capacity to do complex tasks and accommodate a range of applications has experienced exponential growth. Also, microcomputers and other computerized devices continue to undergo miniaturization, making them easier to handle and transport. An abundance of software parallels their development. This paper focuses on software, the Learner Profile, that enabled a computerized device, the Newton MessagePad™ was developed to assist teachers to assess student performances in group and individual tasks. These notations that are entered into the hand-held device are downloaded to a microcomputer for various analyses. The software and device present a promising potential for conducting research in science classrooms. The author describes how he used the Learner Profile for the Newton to assess change in the teaching behavior of three Discovery teachers.

Caseau, Dana

Strand 6 — Sun, 23 Apr, 1995 1:00 PM Oregon

Multicultural Science Education for Diverse Student Populations

Katherine Norman

With the current changes in the demographics in this country and the inclusion of students with disabilities into regular education classes, the make-up of K-college classrooms is undergoing change. Examples of the diverse cultural groups represented include ethnic and racial groups, religions, gender, language, poverty and other socioeconomic groups and individuals with disabilities. Individuals who fall into these categories include children and adolescents who have been labeled "at risk", those identified as "special education" students and students with limited English skills. Many of these students with special needs are isolated, don't assimilate well and often end up in troubled situations. The majority have had few positive experiences in science. During this presentation, the authors will provide: (1) an overview of our diverse student populations in K-college science classrooms, (2) a summary of the categories of exceptionalities served by special education and, (3) a review of the learning styles of diverse student populations and recommendations for science instruction methods. In addition, an orientation to the metacognitive deficits of students with disabilities and cognitive strategies successful with these students will be presented, along with the results of a 1994 survey regarding the perceptions of teachers and teacher educators about the inclusion of students with disabilities in science classrooms.

Castaño, Norma C.

Strand 9 — Mon, 24 Apr, 1995 10:30 AM Monterey

Nociones de los Ninos de Pre-escolar Acerca de las Plantas

Nancy Espitia **Magda Miranda** **Claudia Guerrero**

Se trabajó con 45 noños de preescolar con el fin dedeterminar las nociones de vivo y no vivo utilizando comoobjetos de identificación las plantas y las piedras, respectivamente. Los resultados muestran diferentes tendencias partcularmente una tendencia antropocéntrica que deja ver la concepción infantil del hombre como centro para explicar las cosas que le rodean, endependiente de su naturaleza viva o no. Se destaca una tendencia animismista en la que el niño atribuye intención y conciencia a los objetos físicos y dota de vida a todo cuanto le rodea: La denominación biológica se otorga por el acercamiento que muestran los niños en sus nociones a los términos biológicos y a procesos característicos de lo vivo; no queriendo afirmar con esto que el manejo de dichos términos sea consciente pudiendo ser en la mayorla de los casos un aprendizaje memoristico. En un bajo porcentaje los niños anque consideran que la planta es un ser vivo, no tienen explicación quizá por falta de elementos para hacerlo o por falta de palabras para decirlo.

Cavallo, Ann M. L.

Strand 1 — Sun, 23 Apr, 1995 4:00 PM Monterey

Students' Mental Models of Meiosis and Genetics Topics

Stacy Sheperson

The purpose of this study was to explore high school Biology students' understanding of Meiosis, the use of Punnett square diagrams in genetics and the relationships between these topics. This study used mental modeling, an open-ended assessment technique that reveals the extent and nature of students' understanding of a given topic (Mosenthal & Kirsch, 1992). Mental model assessment illustrates students' understanding of relationships among ideas and concepts and between conceptual and procedural knowledge of a topic. Results from two independent samples ($\underline{N}$= 140, $\underline{N}$ = 189), indicated that after instruction, students had little procedural knowledge but fairly high conceptual knowledge of Meiosis. Conversely, students attained high procedural knowledge of Punnett square diagrams, but had little conceptual knowledge of why this tool is used and what it (biologically) represents. The majority of students in both samples could not explain relationships between Meiosis and the use of Punnett square diagrams. The results imply that educators need to explore new ways to help students formulate relationships between topics and attain more interrelated, meaningful understandings of biology concepts.

Chandler, Frances Tate

Strand 6 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Establishing a Mother/Daughter Science Club: A Case Study

A Mother/Daughter Science Club was established for Grade 5 girls and their mothers. Eighteen mother/daughter pairs participated in this case study which involved meetings on nine consecutive Thursday evenings. Each week a professional woman in a science related field met with the group. The presenter provided a hands-on activity related to her particular field of work for the girls and mothers. She also told a bit about her job, how she became interested in science, the education she received to qualify her for her present job and her life away from her job. The mothers and daughters kept journals during the course of the project. The journals were collected at the end of the nine weeks. In addition, all participants completed questionnaires at the beginning of the project. The mothers met one evening without the girls and the girls met in small focus groups in addition to the weekly evening meetings. Journal entries and observations of the girls at school in the months following the project indicate that the project had a positive impact on the girls attitudes toward science. Long-term follow-up will be necessary to determine the program's long-term effect.

Chang, Ching-Kuch

Strand 10 — Mon, 24 Apr, 1995 10:30 AM Portola

Problem Solving Strategies in a Problem-rich Environment

This study was designed to reveal problem solving strategies in an information-rich environment and to examine cognitive and motivational correlates of particular problem solving strategies. Thirty subjects browsed freely through a 28-item mathematics problem set and solved any problem as they liked it. Problem solving strategies were evaluated on a continuum ranging from random problem solving to planned, investigative problem solving. The finding showed problem solving strategies to be significantly related to spatial ability and need for cognition.

Charron, Elizabeth

Strand 3 — Sun, 23 Apr, 1995 1:00 PM Gold Rush A

The Construction of Beliefs about Science Teaching and Learning by Bilingual Native American Preservice Teachers

This paper presents a case study of a cohort of seven Blackfeet preservice science teachers who have begun coursework at a tribal college on their reservation and who will ultimately transfer to a state university system campus. The study explores the construction of understandings of science and science teaching by the seven novices. The study also examines how these understandings were influenced by extended and social ties within the cohort and the social and cultural environment on the Blackfeet reservation. Through formal and informal interviews with the preservice teachers during a fifteen month period, various issues were discussed. From these discussions emerged five themes which focus on preservice teachers' emerging understanding of science, the connections they made between scientific and Blackfeet ways of understanding the natural and human-made worlds, their familiarity with textbook approaches to science and the connections they made between different models of science teaching and learning and the kinds of social interactions that typify Blackfeet families and communities.

Chevalier, Susan

Strand 4 — Tue, 25 Apr, 1995 2:30 PM Oregon

Involving Preservice Students in a Gender Equity Project

Inservice and preservice teachers are not trained and thus not aware of gender and minority issues in the classroom. Teachers differentiate their responses and expectations for students based on unperceived biases. Building an awareness of differential behaviour toward students is a first step in equity and this equity training must begin within the current education program structures of teacher education. I describe an effort in which, in the Fall of 1994, 200 preservice students are involved in learning about children's knowledge base of equity through a class assignment requiring the preservice teachers to interview children. The activity includes formulation of research hypotheses by the students, who also compile qualitative data, generalisations, conclusions and recommendations.

Chin, Chi-Chin

Strand 10 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Interpreters' Perceptions about the Goals of the Science Museum in Taiwan

Interpreters play the role as the bridge between museum visitors and exhibits. The competence of interpreters especially influences visitors' learning in the museum. This study focused on the National Museum of Natural Science in Taiwan to investigate interpreters' perceptions about: (1) the educational goals of science museum, (2) the function of interpreter in the science museum, (3) the requirements for a competent interpreter and, (4) the interpretation as a professional. Interpretive methods including open-ended questionnaires, interviews and observations were used in gathering the data. The results revealed that interpreters recognized the goal of the science museum was mainly to transfuse scientific knowledge to the visitors. Although instructional skills were employed to motivate museum visits, most of interpreters didn't regard the importance of affective objectives in informal science learning. Interpreters also thought science museums should build a firm relationship with both "the public" and the school systems. Interpreters expected they could become more professional. However, they also mentioned training policy, welfare problems and clarified job description should be solved first.

Chiu, Mei-Hung

Strand 1 — Sat, 22 Apr, 1995 7:00 PM Portola

Self-explanations Promote Science Learning

The use of the method of self-explanations to gain knowledge of the students' conception of chemical equilibrium concepts is reported. The analysis provides information on: (1) a general indication of students understanding of materials related to chemical equilibrium, (2) a deep investigation of problem solving skills associated with the content and, (3) a comparison of successful, intermediate, unsuccessful students' performances which resulted from the pre- and post- treatments. The findings obtained were based on verbal protocols of 12 high school students before, during and after the experiment. Results indicated that high quality of self-explanations promote better understanding of the chemical concepts and principles.

Christensen, Clare

Strand 4 — Sun, 23 Apr, 1995 1:00 PM California

Group Processes in Science Laboratory Work

Campbell McRobbie

This study explored the interactions of a group of students doing practical work in science. Interest focused on the social construction of understanding how this could be described. It was found that the students worked collaboratively in constructing an understanding of the task but rarely went beyond this to a focus on the concepts the practical work was intended to illustrate. Collaboration was described in terms of social behaviours and discourse moves which supported the use of cognitive strategies.

Chyuan, Jong-Pyng M.

Strand 1 — Tue, 25 Apr, 1995 2:30 PM Nevada

Children's Concepts about Force and Motion Before and After Using a Science Textbook in the Fifth Grade of Elementary School

In the course of learning force and motion from a national textbook for Grade 5 in elementary schools in Taiwan, students mainly study the relationship between the motion state of an object and the applied forces to the object. In order to know whether students have meaningful learning in their learning process, there is a need to understand students' cognitive structures after studying force and motion. Then, it can be used to improve teaching materials and teaching activities in the classroom. This research uses concept mapping as a main research tool and then uses interview-about-events to explore children's ideas about it. The results show that about 60% students use "contact force" and "uncontact force" as the main meanings of force and others are "push, pull and elastic force" and "magnitude and direction" as other meanings of force. For the concept of motion, only 35% of students understand that motion is produced by force and about 40% of students are not make sure of the relationships between motion and force. Moreover, some misconceptions exist in students cognitive structure; that is, "balanced force cannot make subject move", "magnetic force will be produced in short distance" and "gravitation will be made only downward". The unit of force and motion in the science textbook should be improved.

Clay, Samuel L.

Strand 5 — Sun, 23 Apr, 1995 10:30 AM Suite 2625

Two Alternative Approaches to Performance Assessment

Richard R. Sudweeks

Hands-on performance assessments in science are one important means of assessing what students can do with what they know. Interpretive (or context-dependent) exercises provide an alternative means of assessing students' ability to use and apply what they know. The purpose of this study was to investigate the relative advantages and disadvantages of these two different modes of assessing students' ability to apply their knowledge about series and parallel circuits. Subjects were undergraduate elementary education majors who had received instruction about the various types of electrical circuits. Subjects' ability to apply their knowledge of electrical circuits was tested by: (1) hands-on performance test and, (2) a paper-and-pencil administered interpretive exercise. Each student completed both tests in a counter-balanced design. A repeated-measures analysis of variance revealed that the students scored significantly higher on the interpretive exercise. Additionally, the interpretive exercise test was more efficient in terms of administration and scoring.

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Clement, John

Strand 1 — Sun, 23 Apr, 1995 2:45 PM Gold Rush B

Analogy Use in Experts and in Instruction

Examples of analogy use were examined in case studies of expert problem solving. Advanced graduate students and professors in technical fields were asked to think aloud while solving a physics problem. Spontaneously generated analogies were observed to play a role in the solutions and several subprocesses involved in analogical reasoning were identified. Critical evaluation of the analogy is especially important. The findings suggest that it will be possible to develop theoretical models for certain patterns of nonformal scientific reasoning. In a second section, I discuss science teaching studies which have attempted to use similar analogical reasoning processes in the classroom and describe one study showing significant differences in favor of experimental high school physics classes using such an approach. This approach also emphasized critical evaluation of analogies. The method is seen as one promising tool in dealing with alternative conceptions in science.

Cobern, William W.

Strand 1 — Sun, 23 Apr, 1995 2:45 PM Nevada

Everyday Thoughts about Nature: An Interpretive Study of Sixteen Ninth Graders' Conceptualizations of Nature

Adrienne Gibson Scott Underwood

Worldview variations may interfere with science education particularly when instruction proceeds unaware of the importance of fundamental epistemological structure in learning. This research addressed the fundamental question of what Grade 9 students believe about *nature*, a delimitation of worldview. The theoretical base involved the use of a worldview model adapted from cultural anthropology, logico-structuralism. Data was collected via semi-structured interviews involving a set of elicitation devices designed to encourage students to talk freely about the natural world. The analysis led to inferences about student fundamental beliefs which were used to develop a description of belief space. The belief space is presented in the form of a concept map and a first person narrative. These are supplemented with a personal descriptive statement for each student. An examination of the student beliefs about nature showed several stances towards nature ranging from the positive to the very negative. Of greater interest were the often surprising reasons behind various stances. Perhaps the most intriguing observation of the study was an apparent disconnection between the science of the school classroom and the natural world of student experience. For several of the sixteen students, science of the classroom was clearly not about the natural world.

Cogan, Leland

Strand 3 — Sun, 23 Apr, 1995 2:45 PM Suite 2601

Ideas about Science and Teaching from Teachers in 14 Countries: An Analysis of Data from Piloted Questionnaires of the Third International Mathematics and Science Study

Richard Houang

The purpose of this study was to assess the differences in teachers' ideas about science and science teaching. The 778 teachers taught one of two student age groups, 9 year olds or 13 year olds, in one of 14 different countries. Teachers were asked whether boys or girls were more likely to be interested in or be good at science, what is important for student success in science, which of several pedagogical approaches they would use when confronted with a specified pedagogical situation, how well prepared they were to teach various science topics and what form of student instructional groups they used. Analyses revealed significant differences in most of these areas both between and within countries. Some differences in teachers' ideas were also found as a function of the age of the students taught.

Coleman, Sharon L.

Strand 2 — Sat, 22 Apr, 1995 8:30 PM Emerald

Spatial Perception Skills of Chemistry Students

Al Gotch

From fall of 1992 to spring of 1994 chemistry students in three different courses were given a paper-pencil reasoning test entitled An Inventory of Piagetian Developmental Tasks (IPDT). Twelve questions from this test were selected to represent visualization abilities and the scores were used to investigate spatial perceptual skills of students with regard to gender. Findings indicate significant differences in test scores between the genders as well as differences of spatial abilities between students in the three types of chemistry courses.

Collins, Angelo

Strand 5 — Tue, 25 Apr, 1995 1:00 PM Crystal

National Science Education Standards: Results of the National Review

Rodger Bybee Audrey Champagne

Symposia participants will present, explain and discuss the results of a national review of the US National Science Education Standards.

Colombo de Cudmani, Leonor

Strand 9 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

The Monochromatic Lightwave Model in Learning Physical Optics

Marta Pesa Julia Salinas

When the conceptions acquired during formal schooling are incorporated into the cognitive structure in a dogmatic and inflexible way they act as an impediment to the learning of related conceptions. This seems to be the case in the learning of physical optics theories based on the oversimplified model of an infinite linearly polarized lightwave of constant frequency and amplitude. This fact is shown by investigations of conceptual difficulties that university students, high school and basic level university teachers have with physical optics. The concept of light coherence, if used as a structural axis for the learning of physical optics, can help in the change of paradigm in those situations in which the ideal monochromatic lightwave model has exceeded its application limits.

Cook, Julie

Strand 2 — Sun, 23 Apr, 1995 8:30 AM Emerald

The Impact of Learned-helplessness on Students: Student Interactions in Cooperative Learning Groups in High School Physics

Lloyd Barrow, Director

This study examined verbal student — student interactions as a product of varying motivational patterns in small cooperative learning groups in physics classes. Ninety-five high school physics students were classified as learned-helpless, mastery-oriented, or neither, by means of a measure of attribution for failure as determined by the Intellectual Achievement Responsibility Scale. They were then videotaped in groups and conversation was coded for four variables: on- or off-task, sender or receiver of the message, positive or negative nature of communication and attributions for effort or ability. Frequencies for the individual interactions were determined by computer program (SAS) using a linear statistical model with split-plot design with repeated measures. Results indicated that there was significant interaction between the frequency of messages received by learned-helpless students and students who were neither learned-helpless or mastery-oriented. Learned-helpless students also made significantly more comments when they were off-task than when they were on-task when compared to students who were not mastery-oriented.

Cracolice, Mark S.

Strand 1 — Tue, 25 Apr, 1995 8:30 AM Washington

The Role of Graduate Teaching Assistants and Alternative Instructional Technologies in Teaching Problem Solving in General Chemistry

Michael R. Abraham

The purpose of this study was to investigate a computer-assisted instruction and semi-programmed instruction as a replacement for traditional recitation/discussion in general chemistry. Both student performance on problem solving and student attitude were investigated. The study also tested the effect of formal reasoning ability as a covariate. The data indicated that for simple problems, all methods of teaching recitation/discussion section were equally effective, but for more difficult problems, the semi-programmed instruction was most effective. The interaction between problem solving performance and formal reasoning ability was significant only on the most difficult problem. Attitude measures showed that students had more positive attitudes when using the semi-programmed instruction than when attending traditional recitation/discussion section.

Crawford, Barbara A.

Strand 2 — Sun, 23 Apr, 1995 8:30 AM Emerald

An Investigation of Collaboration in a Project-based Science Middle School Classroom

This study investigated the collaboration of middle school students in a project-based science environment. In project-based science the teacher and students become part of a community of learners during an extended investigation of a driving question. Students designed team research projects relating to the question, Are Their Poisons In Our Lives? This research used qualitative methods to document and analyze the social interactions of students with many individuals; other group members, other students in the class, the teacher, telecommunications-linked collaborators and community members. One unique aspect of this study is that the researcher is the teacher; the teacher the researcher. The students in the study were my own middle school students. Videotapes of a focus group of students and of the larger classroom setting comprised the primary data source. In addition, my own actions and reactions were not only relevant from a teaching and research perspective, but also as an integral part of the social context of learning science in my classroom. Preliminary findings indicate that motivation was enhanced by the student-centered, collaborative nature of the classroom environment. However, students had varying levels of success in collaborating and working with other students in their group.

Crawley, Frank E.

Strand 10 — Sat, 22 Apr, 1995 8:30 PM Emerald

Beginning Collaborative Action Research in Two High Schools: The Story of SS&C Reform in North Carolina

The purpose of this project was to describe the types of problems of practice that high school science teachers face in two Scope, Sequence and Coordination (SS&C) high schools and the ways in which teachers resolve these problems through collaborative action research. Ten student-researchers and teachers collaborated to: (1) plan, (2) act, (3) observe, (4) reflect and, (5) revise action research projects in the two SS&C high schools located in eastern North Carolina. Multiple data sources were collected in these naturalistic studies, to develop grounded theory concerning the problems of practice related to SS&C reform. Life histories, double-entry journals, stakeholder interviews, field notes and artifacts served as data sources for triangulation of the findings.

Cronin, Patrick

Strand 7 — Sun, 23 Apr, 1995 4:00 PM Portola

A Computer-assisted Scientific Literacy Development Plan

Léonie Rennie Gary Williams

This presentation will take place according to a novel format. The presentation medium will be the HyperCard application for Macintosh computers. The presentation will demonstrate how a derivative of HyperCard was used for the improvement of scientific literacy in high school students. This new model for scientific literacy is called HyperCard Pathways (HCP) model. The features of the model to be demonstrated were designed within physics modules to enable students to generate concept maps, access contextual readings and to write essays within the scientific explanation genre. The presentation will then report the results of a study into the effectiveness of using the HCP which indicated that improvement in scientific writing was beyond that achieved in common practice. The analysis was achieved by using both quantitative and qualitative methods. The products of the study included computer programs, a teacher's manual and supporting materials.

Crow, Linda W.

Strand 4 — Mon, 24 Apr, 1995 2:30 PM Gold Rush B

Evaluation of a National Science Reform Project: Effects of Context on Implementation Strategies, Outcomes and the Reform Process

Ronald J. Bonnstetter Charles E. Coble Thomas Sachse Robert Yager

The purpose of this symposium is to discuss the implementation and evaluation of a national science reform project. The effects of contextual differences will be examined through a study of four different implementation sites in the Scope, Sequence and Coordination Project (SS&C). Outcomes of the overall SS&C project and individual sites will be presented along with an overview of a reform process. Documentation and eyewitness accounts will be provided to allow a history of the project to be built. Results reveal that context has a tremendous impact on all aspects of the reform or change process. Particular examples of these contextual influences will be discussed.

Cuevas-Arteaga, Cecilia

Strand 9 — Mon, 24 Apr, 1995 4:00 PM Monterey

Evaluacion del Programa de Maestria en Ingenieria Quimica de la Universidad de Morelos

La maestría en ingeniería Química ofredcida desde 1984, ha presentado resultados poco satisfactorios y un nivel de deserción alto, a pesar de que en 1993 la tira de materias se actualizó. Este estudio tiene como objetivo determinar las causas principales de deservión, y definir un programa de apoyo a la maestría. Se aplicaron encuestas a tres grupos de alumnos (38 en total): inscitos actualmente, titulados y desertores. Las encuestas trataban tres aspectos básicos concemientes a la institución: Plan de estudios y profesores; Adminstración, cuotas y becas; e Infraestructura de la maestría, y un cuarto aspecto concerniente al alumno: su papel protagónico como estudiante. Los resultados de los tres grupos fueron muy parecidos, y aquf se resumen: "El programacuenta con una tira de materias que satisface las espectativas de los alumnos, y posee profesores de buen nivel académico que utilizan técnicas de enseñanza aducuadas. Para la mayoría de los encuestados las cuotas resultan adecuades, pero una beca sería de beneficio. La infraestructura es insuficiente". En relación al cuarto aspecto, las respuestas fueron muy ambiguas y fué difícul tipificar al estudiante. Se definió un programa de apoyo a la maestría que comprende: espacios, bibliografía especializada, centro de cómputo, becas, e investigación.

Cunningham, Christine M.

Strand 6 — Tue, 25 Apr, 1995 1:00 PM Suite 2601

Research Internships for Freshwomen, College Science Histories and the Retention of Women in Science: A Formative Evaluation of the Women in Science Project (WISP)

Mary L. Pavone Carol Muller

This paper reports the results of a formative evaluation of the Women in Science Project (WISP) at Dartmouth College. Through paid research internships for freshwomen, peer mentoring, career workshops, industrial site-visits, seminars with women scientists, study rooms and an electronic newsletter, WISP aims to increase the number of women enrolling, majoring or pursuing a career in science and engineering fields. Multimethodological evaluation investigated the impact of WISP and distilled some of the crucial decisions and factors affecting women's choice and pursuit of a science major. The research could help improve retention programs for women. Locally, the findings can be used to better tailor Dartmouth's program to the needs of the students it services, given WISP's specific resources and institutional context. However, dissemination of evaluation findings to a larger educational audience is also important. The identification of students' needs, of factors that contribute to female dropout from science and of the successful features of WISP should inform program design and implementation at other institutions.

Czerniak, Charlene M.

Strand 3 — Sun, 23 Apr, 1995 2:45 PM Redwood

Relationships Between Teacher Beliefs and Science Education Reform

Andrew T. Lumpe

Calls for changes in science education have been intense during the last decade, but many of the reform reports have ignored beliefs of classroom teachers. This study sought to answer two research questions: (1) what variables predict teachers' beliefs about the necessity of reform efforts in science education? (2) what variables predict teachers' implementation of science reforms? A random sample consisted of K-12 teachers in Ohio. Beliefs about the necessity of reforms and degree of implementation of reforms were measured by two 12-item Likert scales adapted from a BSCS (1994) instrument (STEBI), a 25-item Likert scale. Teachers' efficacy seems to be a significant factor associated with beliefs and willingness to implement reforms in science classrooms. In a multiple regression model, self efficacy and outcome expectancy accounted for some of the variance in teachers' beliefs about the necessity of reform strands in science education. Self efficacy also accounted for some of the variance in degree of reform implementation in the teachers' classrooms. Findings from this study support the notion that policymakers need to be more cognizant of teachers' beliefs about reform.

Dai, Mei-Fun Wang

Strand 1 — Mon, 24 Apr, 1995 8:30 AM Monterey

Young Chinese Children's Conceptions of Life

What nature is, and what life is, are commonly encountered by children. The purpose of this study was to identify the Chinese young children's conceptions of "life". Fifty-eight children aged five years, from 39 kindergartens in northern Taiwan area, participated in this study. Each child was interviewed by a trained interviewer using a semi-constructed instrument. The results were examined from three alternatives: (1) descriptive statics, (2) naive theories and, (3) individual response patterns. This pioneer study focused on the conceptions of life among the Chinese preschool children in Taiwan. The results of this study can be offered as a reference for cross-culture and cross-age studies as well as for curriculum writer and teachers.

Damnjanovic, Arta

Strand 4 — Tue, 25 Apr, 1995 2:30 PM Monterey

Attitudinal Differences between Preservice and Inservice Teachers toward Inquiry-based Science

Jane Butler Kahle

This paper describes attitudinal differences toward the learning and teaching of science through inquiry between preservice and inservice middle school science teachers. Seventy-three preservice and ninety inservice teachers were surveyed. Separate factor analyses were performed on their responses and the internal consistency of each factor was calculated. Item by item comparisons were made using independent t-tests with a significance level of $p < .05$. Different factor loadings were generated by preservice and inservice teacher responses. For example, in the preservice group, the following factors were identified: *Nature of Science*, *Image of Scientists* and *Characteristics of Science Teachers*. Responses of inservice teachers, on the other hand, led to the following factors: *Contemporary Science Teaching*, *Image of Scientists* and *Traditional Science Teaching*. Results of the t-tests indicated 7 (out of 25) significant response differences between preservice and inservice teachers. The pattern of those differences is best described as differences in their views about contemporary science and science teaching. Inservice teachers, in this study, held more positive views regarding the process of inquiry and inquiry teaching than did preservice teachers. This finding causes one to question if undergraduate education in the sciences and education provides appropriate opportunities for prospective teachers to describe and experience the nature of science.

Dana, Tom

Strand 3 — Sun, 23 Apr, 1995 1:00 PM Gold Rush A

A Look at Cases in the Development of Reflective Practice: A Case Study of Prospective Teachers of Elementary School Science

Nancy F. Dana

Using an interpretive case study design, the purpose of this study was to explore how prospective elementary teachers utilized science content knowledge and pedagogical content knowledge in the rich context of case discussion. This study is among the first studies conducted to document the use and impact of the case approach in science teacher education. Data collection and analysis were framed by a constructivist epistemology. Consistent with interpretive studies, data analysis, which was inductive, yielded five assertions. Implications are presented for including case-based discussions with special emphasis on issues of science teaching and learning in science teacher preparation.

Davis, Elizabeth A.

Strand 7 — Mon, 24 Apr, 1995 8:30 AM Portola

Students' Explanations and Integrated Understanding

Making explanations contributes to knowledge integration for science students. Although students differ in their propensity to make full explanations, they do have the ability to make them at times. We investigate students' use of explanations in a non-traditional science class, exploring how and when students make sense of complex information. This sense-making characterization can help teachers and researchers to determine how we can improve instruction to encourage students to make high-quality, causal explanations and to develop the kinds of characteristics exhibited by "ideal" students in collaborative learning situations.

Davis, Kathleen S.

Strand 5 — Tue, 25 Apr, 1995, 2:30 PM, Gold Rush B

Change is Hard: Pathways and Obstacles to Curricular Reform

This case study describes the process of implementation of a middle school science reform curriculum, the substance of that reform, the factors critical to its implementation and the dilemmas that have emerged. For three years, teachers field-tested an innovative, NSF-funded, science curriculum with a diverse student population. This study was completed following the field test and the curriculum's adoption by the district. Data were collected through: (1) classroom observation, (2) interviews with individuals such as administrators, teachers and students and, (3) state and district documents. The analysis produced issues critical to the reform process: (1) school leaders sought the new curriculum as a vehicle for engagement of all students in interdisciplinary and process science, (2) tensions and dilemmas were encountered as teachers came to the reform with varying educational beliefs, values and experiences, (3) teachers needed to learn new beliefs and instructional strategies to teach the curriculum effectively. (Such learning was fostered but also impeded; the analysis draws a parallel between teacher learning and student learning within the context of the reform curriculum that is based on constructivism) and, (4) through cooperative learning and process science, the responsibility for learning shifts from the teacher to the student.

Davis, Nancy T.

Strand 4 — Sat, 22 Apr, 1995, 7:00 PM, Oregon

Middle School Teachers Learning the Nature and Content of Science Through Scientific Research

Penny J. Gilmer Sam Spiegel

As part of the Science FEAT Program, we examined how experiences in authentic scientific research influence practicing teachers' views and understanding of science. Each of 67 teachers participated in five weeks of scientific research. Part of the research assignment included weekly group meetings to discuss their experiences. Data sources include >75 hours of audiotaped group meetings, electronic mail messages, laboratory notebooks with personal reactions written separate from the experimental data and laboratory field notes. We found the scientific research experiences provided the teachers powerful alternatives to the traditional textbook images most teachers had. There were substantial changes in teachers' conceptions of scientific processes and content. Early indications suggest that these experiences have had significant impact on the reflected that she was so embedded in the research that she started to observe patterns in her data, began constructing her own taxonomies and felt ownership of her data. She plans to give her students the "luxury of immersion" while they collect data in ongoing weekly experiments.

de Castillo, Guadalupe T.

Strand 9 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

A Study of the Use of the Concept of Function Among University Students of the Natural Sciences

Jorge E. Hernández

El propósito de este estudio es conocer las dificultades que presentan los estudiantes universitarios de ciencias naturales, en el uso adecuado de la noción de función, específicamente, en la construcción y representación gráfica de situaciones relacionadas consus carreras. Para tal efecto, se hicieron entrevistas a profesores y observaciones en aulas de cl se a nivel primario y secundario y se aplicó una prueba a estudiantes de la Facultad de Ciencias Naturales y Exactas de la Universidad de Panamá. Se evidencia una desarticulación entre las enseñanza del concepto de función y su aplicación en las ciencias Naturales, así como las deficiencias entre los estudiantes, en el uso de los elementos esenciales que involucra la noción de función.

de Isaacs, Lydia

Strand 9 — Mon, 24 Apr, 1995, 10:30 AM, Monterey

Desarrollo de Destrezas de Pensamiento Crítico en Estudiantes del Curso de Introduccion a las Ciencias Naturales 100b

Matilde Samudio

El propósito de este estudio era determinar el efecto de enseñar las destrezas de pensamiento crítico: analizar argumentos y diferenciar entre argumentos inductivos y argumentos deductivos utilizando una metodologia experimental mediante las integración de las destrezas de pesamiento critico con el contenido del curso de ciencias naturales 100b. Se trabajó con dos grupos de 25 estudiantes (uno experimental y uno de control). A ambos grupos se les aplicó un pretest para medir el pensamiento crítico y al finalizar el semesre se volvió a aplicar la misma prueba. Los resultados estadísticos no mostraron diferencia significativa entre los dos grupos, sin embargo, las observaciones nos indican que el grupo experimental desarrolló una actividad cuestionadora participativa en comparación con el grupo de control.

de Kidder, Francisca Garcia

Strand 6 — Sun, 23 Apr, 1995 1:00 PM Oregon

Educating the Migrant Child with Different Levels of English Proficiency

Charles W. Anderson

The intent of this study is to present the degree to which children of differing proficiency in English and Spanish developed competence in Thinking, Testing and Spanish developed competence in Thinking, Testing and Telling of scientific concepts. The study considers factors that play an important role in students' performance and understanding science conceptually. Students were categorized by level of English proficiency: Limited English Proficient, Moderate English Proficient and High English Proficient. Of the 24 students participating in the summer Science program, six were selected as representatives of the sample. Information presented in the study relied on personal interviews, classroom observations, videotapes and student journals. Findings support the issue that the best medium for teaching children is teaching them in their primary language, the language they identify with. Also, it was found that the use of visual instructional models played an important role in students ability to understand daily tasks. Visual models included books, book guides, pictures, live insects and snails, scientific tools such as microscopes, magnifying lens, rulers, etc.

de Samudio, Matilde

Strand 9 — Mon, 24 Apr, 1995 10:30 AM Monterey

Metodologías Utilizadas en la Ensenanza de la Física por los Profesores Panamenos de Varias Escuelas Pilotos vs Metodologías Propuestas por Diferentes Proyectos Internacionales

Sergio Guerra — Etelvina Medina

De acuerdo con un estudio etnográfico se caracterizó el método utilizado por el docente en la enseñanza de la Física en las escuelas secundarias. Se comparan estas metodologías con las propuestas por los proyectos Harvard, P.S.S.C., CEF y UNESCO. Se concluye que muy pocos docentes utilizan las recomendaciones metodológicas propuestas por algunos de los proyectos internacionales que se les brindaron en capacitación.

Delacôte, Goéry

Strand 10 — Mon, 24 Apr, 1995 2:30 PM Gold Rush A

Is Learning from Science Center Exhibits False Learning?

The design of interactive exhibits in science centers is a complex task. They must encourage scientific experience and social interactions and should raise questions in the mind of the participant. In this session, the principles governing such design will be discussed with particular reference to the San Francisco Exploratorium, and the role of research in identifying the learning that occurs in science centers will be reviewed.

Demastes, Sherry S.

Strand 10 — Mon, 24 Apr, 1995 10:30 AM Portola

The Crisis of Representation: Concept Mapping, Written Explanations and Students' Conceptual Frameworks in Evolution

Ronald Good — Patsye Peebles

The purpose of this study was to demonstrate how the use of a specific interview probe can influence the description of learners' conceptual frameworks. A high school Biology II class was observed daily throughout the school year. From this class, four interview participants were selected for a series of 17 structured interviews which documented students' changing conceptions about facets of evolutionary theory. The types of interview probes used included concept mapping, written explanations, interview about instances, unstructured interviews, prediction interviews and sorting tasks. The results demonstrate that the two probes, most commonly used by researchers investigating conceptual frameworks, concept mapping and written explanation, were often insufficient tools to adequately describe learners' knowledge. Instead, the findings demonstrate that researchers should strive for a high mode validity for their research findings through the use of multiple probes to generate descriptions.

Denning, Rebecca

Strand 7 — Sun, 23 Apr, 1995 4:00 PM Portola

Effectiveness of an Interactive Learning Environment to Teach Problem Solving Skills to Students at Risk of Academic Failure

Phillip J. Smith

In this study a problem-based learning environment, The Biology Sleuth, was designed, developed and evaluated for its effectiveness in teaching important problem solving skills (in particular, diagnostic reasoning) to secondary students considered to be at risk for academic failure. Subjective evaluations from the classroom teacher and the 40 participating students suggested that the learning environment was not only entertaining and engaging, but that it also supported the development of problem solving skills, social skills, communication skills and computer literacy. Additionally, a pre-test/post-test score comparison (using a between-subjects design) revealed a 31% improvement in students' abilities to identify a plausible hypothesis for a given pattern of data after using the system and a 46% improvement in students' abilities to choose the most diagnostic piece of data to discriminate among a set of hypotheses. Additionally, students were video-taped while using the system and discourse analysis of those tapes was performed to model how the system design influenced group dynamics and individual performance.

Deru, David B.

Strand 4 — Tue, 25 Apr, 1995, 2:30 PM, Emerald

Transfer Of Knowledge Through Expatriate Nationals (tokten): The Role of Culture in the Delivery of a Science Curriculum Project in Nigeria

Joseph P. Riley II

The project for developing a science curriculum at a technical institutional setting in Nigeria was funded by the United Nations Development Program. The purpose of this study is to ascertain the perception by participants of differences in cultural effects upon: (1) an expatriate national and, (2) an expatriate nonnational in the delivery of a science curriculum project in a specific cultural setting. Thirty-nine participants received 45 minutes of intensive interview all focused on the development of science curriculum within the cultural setting. The sampled population included both males and females varying in age, education and experience. In this preliminary report, the focus is to gauge the perceptions of participants and their reasons. Results suggest that although perceptions point up a preference in favor of an expatriate national based on cultural grounds, such grounds may form the basis for better understanding about how to bridge the gaps which exist for individuals outside of their native cultural environment.

Desouza, Shireen J.M.

Strand 2 — Sun, 23 Apr, 1995, 7:00 PM, Exploratorium

Inquiring Moments: Capturing Preschoolers Doing Science

This study was designed to investigate learning behaviors exhibited by preschoolers during science activities. Ethnographic procedures were used to collect the data. Preschoolers were observed while they interacted with Insects, Plants and Animals. Their interaction was observed by preservice teachers and the major researcher. These sessions were also video taped. The data were analyzed by the major researcher and two other researchers. The themes that emerged from the preliminary findings were that preschoolers exhibited different patterns of learning behavior which also suggests that boys and girls in the study learned differently and interacted in different ways. Interest in the activities directly correlated with the interests of their playmates. This study emphasizes that even at a very young age, boys and girls show differences in their interests in science activities.

Destino, Thomas

Strand 6 — Tue, 25 Apr, 1995, 8:30 AM, Suite 2601

Observing a Bilingual Teacher Accommodating both Science and Language Objectives

A significant issue in bilingual instruction is the extent to which content objectives and language objectives can be met simultaneously. Anecdotal evidence from teachers indicates that when they have to meet content objectives and language objectives at the same time, they automatically slow down and potentially "water-down" the content. How teachers manage to maintain a balance between these two sets of objectives is the focus of this presentation. The sample for this study is from the population examined in the AVANCE project, conducted at the UC Santa Cruz. Micro-analysis of video recordings along with student portfolios and interviews are the data sources for this study. This study reveals that the inquiry-based, cooperative group approach to science learning not only encourages students to test hypotheses about science, but also hypotheses about second language. Effective teachers consistently use scaffolding as a means of encouraging students to discover science concepts through the second language. This study is expected to contribute to the teacher development literature by describing the impact of science content on second language development.

Dickinson, Valarie

Strand 2 — Tue, 25 Apr, 1995, 8:30 AM, Nevada

Beating the System: Confronting Student Behaviors that Inhibit Conceptual Understanding of Introductory Physics

Larry Flick

The purpose of this study was to describe relationships among instructor goals, course design and student behaviors for learning physics. The results are used to develop a grounded theory for explaining the behaviors and experiences of non-science majors in introductory science courses. The procedures included sixteen hours of participant observation during which detailed field notes were taken, documents collected and photographs taken, as well as audiotaped open-ended interviews of instructors and students and a limited survey of all students. The data was analyzed using qualitative methods of the Chicago School. Results indicate that differing goals of students and instructors and the necessary structure of the course is inhibiting to the understanding of physics and is conducive to students engaging in unexpected behaviors designed to help them make it through the course. The consequences of the structure of the course and subsequent student behaviors inhibit their understanding and appreciation of physics and deter them from enrolling in further science courses. The paper includes implications for teaching introductory college physics.

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Dickinson Bird, Mary

Strand 4 — Tue, 25 Apr, 1995, 2:30 PM, Emerald

Eeks and Geeks: Influencing Elementary Teachers' Views of Science and Scientists

Herman G. Weller

Elementary teachers, like most of the general public, often share a view of science as an intimidating and dangerous enterprise practised by antisocial, fact-filled, linear-thinking individuals who are usually male. In a three week summer academy and school year follow-up, 21 elementary teachers worked with scientists in field and classroom as they began to pursue their own questions about the New England environment. Their beliefs about science and scientists were examined through questionnaires, journals, discussions and interviews, with the expectation that the personal relevance of the investigations, the careful selection of a diverse group of field and lab scientists and the use of familiar equipment and easily accessible field settings might lead to a change in teacher perceptions, as well as to modifications in teaching practice from a linear, teacher-directed approach to a more inquiry based, student centered style. Although many of the teachers did in fact show dramatic change in their thinking about children as scientists, this change did not seem to infiltrate their more deeply-held personal beliefs about science and scientists, or their most ingrained professional ideas about how to prepare and support children to take ownership of scientific investigations.

Dierking, Lynn D.

Strand 10 — Sun, 23 Apr, 1995, 2:45 PM, Gold Rush A

Utilizing Interpretive Carts to Collect and Analyze Visitor Conversations in a Natural History Museum

Dana Holland

As part of the Smithsonian's National Museum of Natural History effort to redesign of the Geology, Gems & Minerals Hall, a constructivist methodology was developed to unobtrusively assess visitor knowledge and interest about specific geologic concepts and specimens. Data were collected utilizing a "Rock Talk" interpretive cart. As one investigator supervised the cart, another took detailed notes of all "rock talk". A total of 482 interactions were recorded with 280 visitors; visitors interacted with the cart in one of two ways, either asking questions or making statements. Content analysis of conversations revealed that most visitors had low to moderate knowledge of geology concepts but high interest in the topic. Some specimens, such as malachite, were able to provoke visitors even with minimal knowledge to ask higher level questions.

Dillon, Justin

Strand 4 — Mon, 24 Apr, 1995, 10:30 AM, Gold Rush B

Fourth Down and Fifty: The Role and Responsibilities of UK Consultants in an Indonesian Inservice Education Project

Martin Monk

Science Educators from King's College London have been involved since 1986 as consultants to the Indonesian Government in probably the largest inservice programme in the world. The research study looks at the changes in the nature of the advice given and the strategies used in training as reflected in reports, field notes, training handbooks and interviews. An analysis is made of the changes in advice in terms of factors including paradigm shifts in science education in England.

Doherty, Cindy L.

Strand 4 — Sat, 22 Apr, 1995, 7:00 PM, Oregon

A Performance-based Instructional Technology Course for Practicing Middle Grades Science Teachers: The Rewards and Challenges

The inclusion of instructional technology in science teacher education is one of the issues at the forefront of many, if not all, teacher educators' agendas. This study examined the effectiveness of a performance-based instructional technology course designed as part of the Science FEAT program. This course allowed teachers to set and strive for personal, instructional technology goals similar to a model of individual development suggested by Sparks and Loucks-Horsley (1990). Specific questions guiding the study were: Did the course meet the needs of individual teachers and the program? Was the course manageable with respect to a large number of teachers and time constraints? And, were the products high quality? Other areas examined were: How this student-centered course compared to previous teacher-centered courses; and the influence of this course on individual instructional practices. Data gathered from surveys, interviews and personal reflections support the assertion that a performance-based course is an effective instructional method. However, results also indicate that not all teachers are comfortable with the role of independent learner. Suggestions for additional types of instructional support in such a course are offered. Also, specific complexities such as the negotiation of goals and assessment are discussed.

Dooms, Patrick

Strand 6 — Tue, 25 Apr, 1995 1:00 PM Emerald

Language, Culture and the Learning of Science: An Empirical Study Based on Venda-speaking and Tsonga-speaking Students' Understanding of the Solar System

Paddy Lynch

A comparative study of students' understanding of the solar system particularly, their conceptualization of models for the Earth, Sun, Moon system was undertaken in Johannesburg and in Venda- and Tsonga-speaking areas in South Africa. Comparable groups of students at the elementary/secondary and secondary/higher education interface were interviewed in their home languages: English, Venda and Tsonga. The language/culture groups were chosen on the basis that the Venda- and Tsonga-speaking people were similar in terms of acculturation, and represent one of the greatest linguistic differences for Southern African languages. The main purpose of the study was to explore to what extent language and culture are associated with students' alternative frameworks and to add insights regarding the choice of language of instruction in 'developing' societies.

Doran, Rodney L.

Strand 5 — Sun, 23 Apr, 1995 1:00 PM Redwood

Alternative Assessment in Science in New York State

New York State has used a performance exam as part of the final exam for the Regents earth science course since 1970. Beginning in 1989, a test of science manipulative skills has been administered to all fourth-grade students as part of the Elementary Science Program Evaluation Test (ESPET). These two performance-based tests are administered and scored by teachers in each school, with the help of various printed materials and regional workshops. With the help of a National Science Foundation grant, further work is being conducted to develop and validate additional alternative assessment instruments for Grade 8 Science and high school introductory Biology. These new assessment tasks are being prepared for potential statewide assessment and/or collection of tasks for local school student evaluation. Many task formats are currently being studied, especially those requiring student active exploration and construction of written response to open-ended items. This paper will describe the involvement of teachers at each step of this very slow process and how difficult it is to cultivate the skills needed by teachers to fully participate in the process of performance assessment. It will also describe research data on various measurement issues associated with performance assessment.

Dori, Yehudit J.

Strand 1 — Mon, 24 Apr, 1995 10:30 AM Oregon

In-Service Training for Leadership: Incorporating Environmental Aspects into Chemistry Teaching

O. Yeroslavski R. Lazarowitz

Three 56 hour in-service teacher training sessions have been conducted at the Technion, since summer 1993 and consisted of 20-25 chemistry and Biology teachers, each. The aim of the training was to incorporate science-technology-environment-society (STES) issues in Chemistry teaching, to foster STES leadership among teachers and to expose them to the related subject matter, teaching methodologies and team work. The assumption was that exposing the teachers to system approach in teaching and analysis of case studies, expert lectures, laboratory experiments, field trips and team projects will induce a "desired" STES-oriented conceptual and perhaps behavioral change. The teachers worked in teams and prepared short teaching modules incorporating the STS approach and the relevant teaching strategies. The assessment of the training was done by the participant teachers through a specially constructed two-part self-evaluation questionnaire. Most of the teachers indicated that they have increased their involvement in the school annual environmental project, helped colleague teachers to further develop STES modules and became leaders of the science-technology-environment-society movement in the schools. Currently, seven teachers of the trainees are taking active part in a "science-technology-environment in the modern society" national project of developing and implementing STES modules in high schools, accompanied by their corresponding active research in their classrooms.

Dorman, Jeffrey P.

Strand 2 — Mon, 24 Apr, 1995 4:00 PM Suite 2601

Associations Between School-level Environment and Science Classroom Environment in Australian High Schools

Campbell J. McRobbie Barry J. Fraser

Few studies have investigated links between school-level environment and classroom-level environment in high schools. This paper reports research exploring associations between school environment and science classroom environment in Australian high schools. A sample of 1,319 students from 64 science classes responded to a seven-scale classroom environment instrument. The teachers of these classes also responded to a teacher form of this instrument. The assessment of school environment involved a sample of 128 teachers from the 32 high schools in this study. These teachers responded to a seven-scale school environment instrument. Simple, multiple and canonical correlational analyses generally indicated weak relationships between the overall school environment and the environment of science classrooms. It cannot be assumed that a positive school level environment is sufficient for positive science classroom environments.

Dorough, Donna K.

Strand 1 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Fifth and Sixth Grade Students' Explanations of Global Warming and Ozone: Conceptions Formed Prior to Classroom Instruction

James A. Rye Peter A. Rubba

The purpose of this study was to investigate students' conceptions of global warming and ozone prior to receiving classroom instruction on these STS issues. Subjects were twenty-two Grade 5 and 6 grade students in rural elementary schools. Standardized open-ended interviews were conducted during the last month of the school year. Responses to selected questions were analyzed using transcripts of those interviews. Analysis of the data suggested that the students generally fit into two distinct groups: (1) those with very limited understandings of the issues and, (2) those with a broader understanding of the issues. The limited understandings group did not make inappropriate connections between global warming and ozone, while those students who were more familiar with the topics typically cited ozone layer depletion as a major cause of global warming. These findings indicate that as young children's scientific knowledge and vocabulary base increases, so does the prevalence of alternative conceptions. The results of this study emphasize the necessity of investigating students existing views prior to planning and implementing science instruction and designing science curricula.

Douma, Joost J.

Strand 10 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Prototyping for the 21st Century

In December this year, construction will start on IMPULS, the Dutch centre for science and technology. We plan to open on 1 August 1996. In order to accomplish this we chose an Italian architect, Renzo Piano, who designed us a building that will be elegant, sensual and modern; yet it will also meet the old town with an exterior of traditional materials—copper and brick. The building further relates itself very intentionally to its immediate context: the roof will be freely accessible and we have commissioned a Japanese artist to turn it into a sculpture garden, enlivened with kinetic art. On summer evenings, a kind of ballet will be performed on the roof with references to current developments in science and technology. The visitors' experience should encompass educational, social, as well as personal elements. Our exhibitions will include the natural sciences, social sciences and also (kinetic) art pieces. "Inspiration", "stimulation", "curiosity", "encouraging confidence", "motivation" and "fascination" will be more central to us than worries about scientific facts and figures, however much information visitors can gain from us. The key message we would like to communicate to our visitors sounds like this: "We think you are worthwhile. Each of you is gifted with certain talents and we invite you to take active part and enjoy yourself in our centre. We also need you as an active, creative and curious member of our society." After the opening, our visitors will certainly give us enough food for thought on where we have succeeded and where we should be doing better. In prototyping for the 21st century.

Duek, JodyLee E.

Strand 1 — Tue, 25 Apr, 1995 8:30 AM Washington

Learning Issues Identified by Students in Tutorless Problem-based Tutorials

LuAnn Wilkerson

Of concern in the problem-based learning process in medical student education is the effect of allowing students to generate their own learning issues while discussing cases. We used a qualitative approach to explore relationships among: (1) student-generated learning issues in tutorless groups, (2) faculty learning objectives and, (3) examination performance. The mean percentage of instructor learning objectives that were identified by students was 84%. Students identified 79% of the faculty objectives in normal structure and function, 92% in injury/disease, 69% in diagnostics, 92% in treatment and 70% in psychosocial issues. Exam performance did not differ among groups. This problem-based learning methodology is applicable to science classes at all levels, from about Grade 3 onward, and is being used with great success and much student interest.

Duffy, Maryellen

Strand 1 — Mon, 24 Apr, 1995 8:30 AM Nevada

Effects of Constructivist and Computer-facilitated Strategies on Achievement in Heterogeneous Secondary Biology

Bill Baroway

Photosynthesis and plant respiration have been identified, not only as two of the most important concepts in secondary Biology, but also as difficult topics for students to comprehend. After instruction, students often continue to express alternative ideas and incomplete understanding of plant nutrition. We are investigating the differential effects of traditional, constructivist and computer-mediated constructivist strategies on critical thinking skills and conceptual understanding of photosynthesis and respiration in heterogeneously grouped secondary Biology classrooms.

Duit, Reinders

Strand 10 — Sun, 23 Apr, 1995 4:00 PM Emerald

Recent Trends in European Science Education Research

Rosalind Driver, John Gilbert, Richard Duschl, Philip Adey, Theodore Wubbels, Onno de Jong, Fred Korthagen

In early April 1995, the first European conference on science education will be held in Leeds (UK). It is most likely that a European Association of Science Education Research will be founded there. The organizers of this symposium will provide information on recent trends in European science education on the background of the papers presented at the conference from the perspective of a number of European countries and the US. To widen the perspective, John Gilbert will present major findings of a survey on science education research in European countries which he conducted in 1993/94. Finally, the new European Association of Research in Science Education will be presented as well as plans for future development and coming conferences. The symposium, therefore, provides a forum for discussing plans of NARST to gain recognition as an international organization and to consider cooperation between NARST, the new European association and other associations of science education research.

Durham, Mary E.

Strand 4 — Sun, 23 Apr, 1995 8:30 AM Emerald

An Analysis of the Responses of Science Student Teachers to Pupil Questions

This study examined characteristics of pupil questions and student teacher responses in the secondary science classroom, and explored changes in student teacher response skills during student teaching. Twenty-one student teachers enrolled in the secondary science teacher preparation program at NCSU participated. Attitudes held toward questioning and responding by the student teachers and their co-operating teachers were measured with an attitudinal survey. T-test results indicated both parties highly valued questioning and responding. Student teachers made three video tapes of a class they taught during the entire student teaching experience. Tape analysis identified strategies used to field pupil questions, the type and level of questions and responses, and changes in student teacher responses. Findings revealed a preference in the response strategies used according to the cognitive level of the student question. Below cognitive level responses constituted a sizable portion of the responses to higher level student questions. Student teacher interviews confirmed these findings. Student teacher response skills were highly rated by co-operating teachers at the beginning and end of student teaching. T-test results revealed no significant difference in the two evaluations.

Duschl, Richard A.

Strand 2 — Sun, 23 Apr, 1995 10:30 AM Gold Rush A

Discourse Analysis as a Window into the Classroom

Leslie Petasis

This paper reports on how assessment conversations (AC) contribute to changes in classroom discourse patterns. The AC involves five steps: (1) students' tasks that produce a diversity of learner responses, (2) public display of the diversity of products and ideas, (3) whole class consideration of diversity, (4) whole class decision to reduce diversity and, (5) application to a different arena. Data sources include videotape recordings and transcripts. The analysis is at three levels — activity analysis, content analysis of AC, and classroom thematic pattern analysis. Discourse guidelines by Gee and Lemke are employed for the analyses. The data suggest that teachers are more skilled in conducting assessment conversations on how students communicate scientific ideas than they are at addressing the quality of those ideas. Two implications of this research are the development of a procedure that focuses on classroom discourse and the use of this information with teachers as a mechanism for them to receive feedback concerning the strengths and weaknesses of their teaching in an assessment-driven learning environment.

Duschl, Richard A.

Strand 10 — Mon, 24 Apr, 1995 4:00 PM Redwood

Publishing in NARST Publications

William C. Kyle, Jr, Larry Scharmann

Rick Duschl, NARST Publications Committee Chair, Bill Kyle, Editor, *Journal of Research in Science Teaching*, and Larry Scharmann, Editor, NARST News will: (1) describe the goals and purposes of NARST publications, (2) describe procedures for submitting materials for publication, (3) respond to questions about NARST publications, (4) discuss suggested changes in NARST publications and, (5) solicit members' ideas for new publications.

Dykstra, Dewey I. Jr

Strand 1 — Sun, 23 Apr, 1995 10:30 AM Portola

Constructing New Ideas about Light and the Formation of Images

William Smith

Starting with prior research, we have embarked on the development of instructional materials which are intended to induce conceptual change and which make possible observation of conceptual change processes and intermediate conceptual states of understanding about light and real images. Each time a new group of students goes through the unit, we see the results of previous research on students' prior conceptions reproduced. The emphasis in the unit of instruction is on student developed models of image formation and not on formally accepted declarations of "scientific knowledge", hence most of the classroom and laboratory time is spent with students discussing with each other their predictions, the reasons why the predictions make sense at the time of the other predictions and ideas they hear, reasons for accepting or rejecting ideas that they hear and checking predictions against the phenomena. The final version of the materials, the result of at least five iterations involving hundreds of students, are the result of an interplay between topics we intended the students to consider and the issues they found significant along the way, resulting in a number of the traditional topics being eliminated from the unit. The instructional environment and materials induce significant change in students' notions about light and the formation of image.

Edgington, Judith R.

Strand 10 — Mon, 24 Apr, 1995 8:30 AM California

How Research Physicists and High School Physics Teachers Deal with the Scientific Explanation of a Physical Phenomenon

James P. Barufaldi

The purpose of this study was to investigate how researchers and teachers deal with scientific explanation. Three research physicists and five secondary physics teachers were asked to explain the Newton's Cradle demonstration. Written answers and follow up interviews were analyzed. All the respondents viewed the events as a series of collisions and related the phenomenon to the concepts of energy and momentum; however, the arguments proposed as explanations differed in depth and in complexity. Results suggest that the differences in performances were related to: (1) the perceived purpose of the explanation and its nature, (2) the number of paradigms invoked for possible ways to describe the events, (3) the specification of assumptions underlying facts or data statements, (4) the examination of assumptions made to determine initial conditions, (5) the choice of variables and unknowns, (f) the proper application of scientific principles and, (6) the assessment of the entire argument in view of acceptability of the underlying model and assumptions.

Edmondson, Katherine M.

Strand 4 — Sun, 23 Apr, 1995 10:30 AM Nevada

Using Metacognitive Tools to Facilitate Faculty Development

Joseph Novak — Kym Fraser — James Wandersee — Carl F. Berger

The papers will discuss the use of metacognitive tools in work with faculty development programs. Among the tools that will be described and illustrated will be concept mapping, concept circles and Vee diagramming. Faculty development will be viewed from the perspectives of the individual as well as the institution as it relates to reflective practice and broader issues of curriculum development and reform. The papers will present examples of how these tools have been used successfully to help faculty members organize their subject matter and to assist them in understanding constructivist views on student learning. The papers will include work with both school-level teachers and university faculty. Data will be provided to indicate the response from faculty to different development programs. characteristics of programs that are best received, problems associated with the use of metacognitive tools and potential areas of further inquiry.

Ellis, James D.

Strand 4 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Intervening in the Professional Development of Science Teachers: The Colorado Science Teaching Enhancement Project

Donald E. Maxwell — Paul J. Kuerbis

Colorado Science Teaching Enhancement Program (CO-STEP) strives to improve the background in science content and the teaching skills of teachers in Grades 4 through 6 throughout Colorado and to support the development of effective instruction. BSCS is forming a network of six Teacher Development Centers in Colorado and is conducting a professional development program for teacher educators and implementation specialists from those six Centers. CO-STEP employs a constructivist approach to the professional development of teachers. During three years of participation, teachers complete a series of courses (28 semester credits) to develop and apply their knowledge of science content, curriculum, instruction and assessment. Throughout the 60 months of support from the National Science Foundation (NSF), teachers develop instructional skills, including cooperative learning, constructivist-based teaching strategies, innovative assessment procedures and strategies for equitable teaching and learn to use educational technology effectively. Participating teachers adapt instructional units from extant curriculum materials and field test, evaluate and revise the units for use in their classrooms.

Enochs, Larry

Strand 4 | Sat, 22 Apr, 1995 7:00 PM Redwood

The Development and Partial Validation of the Beliefs About Learning Science Instrument: A Measure for Secondary Students

Richard Audet

This study is centered around the development of and partial validation of a beliefs about learning science instrument. The Beliefs About Science Learning (BSL) instrument was developed through the modification of the STEBI-A instrument used to assess the self-efficacy beliefs of teachers. The new instrument was piloted on 257 high school science teachers from the northeast. Resulting from the investigation is a personal efficacy scale that has a reliability of .84. The BSL is consistent with Bandura's social learning theory and represents a reliable tool for further investigations into the beliefs of high school science students.

Evans, Robert H.

Strand 10 | Tue, 25 Apr, 1995 2:30 PM Suite 2601

Gender, Structure of Out-of-School Experiences, Motivation and Science Learning in School

Jurgen Baumert Helmut Geiser

This study's aim was to find out how the knowledge and control beliefs, which elementary students acquire in everyday experiences outside of school, stimulate or interfere with their learning of science. A comparable cross cultural sample of 520 ten year olds from Germany and the United States was questioned for their out-of-school experiences in technical and household domains, self-concepts of ability, domain specific attribution patterns and science achievement. The cross-cultural equivalence of the measuring instruments and the assumptions of causal relationships were tested using structural equation models, which were then validated cross-culturally in a multiple group comparison. It was found that the gender gap is greater for experiences with technical objects than for household ones. Science teaching seems to use students' technical everyday experiences constructively, so that everyday knowledge is activated in school. Rich everyday experiences seem to have an important influence on developing a strong sense of self-efficacy in the corresponding domain. Perceived technical competence has a substantial impact on science learning in school. The structure of these patterns was found to be valid across cultures.

Fairbrother, Robert

Strand 4 | Mon, 24 Apr, 1995 10:30 AM Gold Rush B

Negotiated Intervention: Partnership in Inservice Education

The Centre for Educational Studies at King's College has been involved in several projects in which science educators at the College have worked with teachers in schools to identify and try to solve problems in teacher education and development. This paper reports on two projects, OPENS—Open-ended work in Science Project and TAPAS—Teacher Assessment of Pupils: Active Support. The methods of working and the main findings will be reported. Significant parameters which affect what happens are commitment, ownership, risk external pressures and conflict.

Falk, John H.

Strand 10 | Sun, 23 Apr, 1995 2:45 PM Gold Rush A

Assessment of the General Public's Life Science Conceptual Frameworks

As part of the redesign of L.A.'s California Museum of Science and Industry, a front-end assessment of the general public's conceptual understanding of life science concepts was undertaken. Semi-structured interviews were conducted with 70 demographically representative visitors. A total of 12 questions were posed on topics including reproduction and genetics; cell physiology nutrient and energy acquisition and how organisms defend themselves against parasites and enemies. Museum visitors, on the whole, appeared to possess a rudimentary understanding of the life functions shared by all life forms; they did not possess a deep understanding. Visitors' understanding of Biology and their interests in Biology, tended to be very anthropocentric. Visitors had a sense of what an organism needs to do "externally" in order to survive, but not a full appreciation of what an organism needs to do "internally" in order to survive. Findings will be discussed in relation to other life science conceptual framework research.

Farragher, Pierce

Strand 7 | Tue, 25 Apr, 1995 8:30 AM Portola

Developing a Computer-based Portfolio System by Means of Action Research

Bryan Potter

The Sooke School District in British Columbia is changing the structure of its school system by introducing middle schools. This change provided an opportunity to develop a new means of reporting and passing on student information from elementary school to middle school. The schools emphasise technology and easy access to information over high speed networks. A form of reporting which used electronic means of storage and data transfer, rather than paper, seemed logical. Current trends encourage the use of portfolios by students to keep an on-going record of progress. In this project, students developed an electronic portfolio. This provided an efficient means of recording students' achievements and interests while training the students to use the latest techniques in computer technology. The aim was to send the portfolios of Grade 5 students electronically to the middle school, at the end of each school year. An Action Research group was formed to develop the format for the portfolio. The program was developed using FileMaker Pro on a Macintosh. The software included samples of student work i.e., handwriting or printing, stories, poems, math sheets, art work, research projects, text files, oral reading samples and video samples of P.E., music, drama, social studies and science activities. A demonstration will be given.

Feldman, Allan

Strand 8 — Sun, 23 Apr, 1995 10:30 AM Suite 2601

A Tale of Two "Isms": Constructivism in Practice

This study uncovers the various meanings of the term constructivism in science education through a biographical case study of a science teacher who adheres to two "isms" - constructivism and fundamentalism. A philosophical study, using critical and hermeneutical methods, was done of the relationship of the teacher's conceptions of science, knowledge and constructivism to epistemological, psychological and pedagogical forms of constructivism. It was found that he had a complex personal epistemology and belief system that corresponds only loosely with the literature of constructivism. This is compounded by his adherence to both a constructivist view of scientific knowledge and to the positivist world view of a fundamentalist. These findings suggest three problematic areas in the literature on constructivism in science education: confusion over what is meant by knowledge, the identification of learners, and what is meant by constructivist pedagogy. In addition, the literature is not clear in distinguishing among epistemological, psychological and pedagogical forms of constructivism. This can lead to a segmented conception of constructivism in which it is possible to hold any combination of constructivist and non-constructivist beliefs and to a dogma of constructivist pedagogy.

Fetters, Marcia K.

Strand 2 — Sun, 23 Apr, 1995 1:00 PM Nevada

Role Negotiation: Implications for Special Education High School Biology Students Working in Small Groups

This study tells the stories of three special education students: Josh, Carl and Heidi, included in a heterogeneous Biology class. To understand how special education students develop scientific understanding students interactions in small groups were observed daily over a semester. The cases illustrate some of the issues that arise when students learn science in heterogeneous classes. Josh, Carl and Heidi, who in another setting might not have received science instruction at all, clearly benefited in some ways from their inclusion in these science classes. Yet, even with good teachers making well-informed efforts, they experienced frustration and failure. As these cases illustrate there are still many barriers to achieving scientific literacy for *all* students. This study provides insight into how all students negotiate their role in a classroom and shape the agenda of a class. Specifically this study examines the following questions: How do special education students interact in small groups? How do they negotiate their roles with their peers? What are the implications for student engagement? And what are the implications for developing understanding?

Finley, Sandra J.

Strand 2 — Sun, 23 Apr, 1995 8:30 AM Emerald

Personal and Social Sense-making: Learning Science in the Junior High School Classroom

Frank E. Crawley

A concern among science educators is that current classroom practices do not give students the chance to understand science. The purpose of this study is to investigate how students in the middle grades can use informal journal writing and collaborative discussion to make sense of the science they are learning. We holistically examined what happens in the classroom when the teacher decides that informal journal writing and collaborative discussion are valued activities that she believes will lead to a more complete and personal understanding of the scientific phenomenon under study. This ongoing investigation is a qualitative study being carried out in a natural school setting with three collaborating teachers. Multiple data sources include student journals, interviews with students and teachers and classroom observation. We looked at the students' understanding of concepts, their recognition of interconnections between science concepts and between those concepts and everyday life and the relationship between writing and discussion in the class.

Fisher, Robert L.

Strand 5 — Mon, 24 Apr, 1995 10:30 AM Suite 2625

Integrated Learning: Can It, Should It, Be Done?

Vickie M. Williamson, John E. Penick, Susan L. Westbrook, Emmett L. Wright

The Symposium will examine a major conflict arising among three constituencies: the reform movements for better education in mathematics, science and technology; those who have traditional views of the nature of subject matter and learning; and the restraints of those in the schools to adopt these programs. Specifically, the symposium will examine conflicts in moving toward integrated learning in the sciences and with other disciplines such as mathematics and technology. The symposium will seek ways to evaluate such programs in the schools. The conflict will be described in the context of innovative programs that integrate mathematics, science and/or technology.

Fleener, M. Jayne

Strand 8 — Sun, 23 Apr, 1995 10:30 AM Suite 2601

The Myth of Normal Science in the Shadow of Chaos

Chaos theory, dissipative structures analysis and complexity theory have been used in various branches of the sciences to examine patterns of change in complex systems. Habermas described three fundamental human interests (technical, practical, emancipatory) related to the empirical-analytic, historical/hermeneutic and critical orientations to knowing. Habermasian interest categories structure individual interpretations of experiences and reflect orientations toward knowing. This study investigates students' perceptions about scientific inquiry from both Habermasian and New Science perspectives using a researcher designed survey. Findings suggest students are not steeped in the Newtonian tradition and approach their study of science from hermeneutic and emancipatory as well as control orientations. Understanding and capitalizing on hermeneutic and emancipatory perspectives will allow us to explore with our youth the complexity of the universe in a non-reductionist way.

Flick, Lawrence B.

Strand 3 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

Complex Instruction in Complex Classrooms: A Synthesis of Research on Inquiry Methods and Explicit Teaching Strategies

Two areas of research have come to dominate the landscape of classroom teaching. Research on teaching for inquiry seeks to improve student higher order thinking skills and ability to apply knowledge to divergent problems. Research on effective teaching seeks to identify variables that improve teacher ability to achieve educational objectives. Implications from these two areas of research have often appeared contradictory and researchers have tended to place methods in competition. This paper reviews and synthesizes literature in these areas to examine what Good and Brophy (1994) call "false dichotomies" that confuse means with ends. The synthesis of research identifies similarities between the two bodies of work with respect to use of concrete materials, importance of prior knowledge and importance of teacher knowledge of subject matter. Differences include assumptions about capabilities of learners, strategies for remediation and specificity of objectives. The author examines the literature on the limited use of inquiry methods and proposes principles to support teacher use and adaptation of inquiry-oriented methods in a broader range of classroom conditions.

Foley, Brian

Strand 7 — Mon, 24 Apr, 1995, 8:30 AM, Portola

Using a Knowledge Integration Approach to Teach the Physics of Sound

Encouraging students to integrate their intuitive ideas with principles learned in schools is important in developing robust understanding. We report on a curriculum for the physics of sound designed to encourage knowledge integration. The subject domain, sound, is discussed as a novel topic in science education. The students' intuitive ideas on this topic are assessed. The development of the curriculum and computer software are described. An assessment of the curriculum in a middle school science class is given based on student work and pre/post test scores. Results indicate the role of the students' conceptual model in analyzing everyday situations. Students with useful models had more success at integrating their knowledge. Implications for curriculum and software refinement are given, especially for the role of computers in assisting students in mental model construction.

Fox, JoAnna

Strand 5 — Sun, 23 Apr, 1995, 4:00 PM, California

Does a Summer Industrial/Research Experience Make a Difference? An Application of the PACE Model to the GIF Program

John R. Wiggins David P. Butts

It is impossible for a teacher to help students see the relevance of the mathematical and science understanding of the classroom to their contemporary world if that teacher has never experienced those connections. The Georgia Industrial Fellowships for Teachers is a cooperative venture designed to enhance the personal experiences of teachers. From that enhancement, it is hoped that better mathematics and science experiences for their students will result. The PACE model was used to determine the congruence between what was expected from the program and the changes implemented in the classroom experiences of students. This report describes the results of 44 middle and secondary science and mathematics teachers who participated in the 1993 summer program. By the end of the first three months of the 1993-1994 school year, these teachers reported the effect of their access to new information during the summer were changes in their classroom involving using new instructional materials and new teaching strategies. While they valued their personal knowledge enhancement before and after the summer experience, they believed that other people saw less evidence of this change than they. Their renewed enthusiasm for teaching and opportunities for linkage with "real world" and other teachers as resources were much above their initial expectations.

Fraser, Barry J.

Strand 10 — Sun, 23 Apr, 1995, 10:30 AM, Emerald

Development and Scope of the Book "Improving Science Education: International Perspectives"

Jan Harding

Because of the current worldwide importance given to science education, the International Academy of Education commissioned a book which would come to grips with important issues and problems in science education. This purpose was accomplished by requesting reviews of research from distinguished specialists in science education, and requiring that the practical implications of the research be drawn out explicitly. Because no country has a monopoly on effective policies, practices, and research in this field, scholars, practitioners, and consultants for chapters for this book have been drawn from many countries in various parts of the world.

Freeman, John G.

Strand 5 — Sun, 23 Apr, 1995, 10:30 AM, California

New Directions for Science Institutes: The Project-based Science Experience

Ronald W. Marx

This study had dual objectives. The primary objective was to analyze aspects of the Project-Based Science (PBS) Spring Institute that would be transferable to situations where university researchers were helping teachers adopt a more constructivist approach to science teaching. A secondary objective was to identify components of the institutes participants felt were most beneficial for them, so future institutes could be modified. As helping teachers change, the means of conducting institutes must respond accordingly. The themes presented by this research suggest directions for such modifications.

French, Jenice

Strand 4 — Sun, 23 Apr, 1995 2:45 PM California

Teaching and Learning as Empowerment: A Case Study from Elementary Science Teacher Education

Thomas Kuhulla, Jr

A case study approach was selected to explore prospective elementary teachers' beliefs about empowerment and the distribution of power within the classroom incorporating emancipatory strategies. Seventeen women enrolled in an elementary science methods course participated. Data included student journal entries, interview transcripts, field observations and questionnaire responses. The primary unit of analysis focused on three women, while a secondary unit analysis centered on the entire class for breadth and depth of analysis. Constant comparative methodology guided data coding, revealing the core categories of knowledge, experience, and affect. The following assertions emerged from the categories: (1) prospective elementary teachers who personalise knowledge and understanding are more likely to view it as empowering, (2) emancipatory strategies that are irritants to the prospective elementary teachers prompt reflection on knowledge and understanding, (3) "getting to know one another" is a precursor to voice, (4) if there are mismatches in the role expectations of small group interaction, it is more likely that the women will maintain group affiliation without using the renegotiation option, and (5) if the male instructor is perceived as open-minded, the more likely the female prospective elementary teachers will perceive an access route to knowledge through relationships of reciprocity.

Friedman, Jeffrey S.

Strand 7 — Sun, 23 Apr, 1995 4:00 PM Portola

Image Processing in a Science Classroom: Students' Interpretations of Images

This report is based upon a high school physics/astronomy class in which students use image processing software and digital images of astronomical objects. These tools and data are provided by the Hands on Universe Project, an outreach program from Lawrence Berkeley Lab to high schools. This report is part of a larger study addressing questions. How are these tools used in the classroom? how are the tools and data understood by students and teachers? what are appropriate pedagogical goals? This report focuses on students' interpretations of astronomical images. We have found that students' interpretations vary widely in the ways they apply their intuitions and principled knowledge of science and technology. Interestingly, students seem to switch between intuitive and disciplined interpretations. A probable explanation is that the use of images draws out students' intuitions which may compete with disciplined knowledge of science and technology. This study suggests the fruitfulness of further investigation into the circumstances under which students apply their knowledge when interpreting images.

Gabel, Dorothy L.

Strand 10 — Mon, 24 Apr, 1995 10:30 AM Gold Rush A

The Handbook of Research in Science Teaching and Learning: A Review of the Past and a Look to the Future

Ronald D. Anderson Anton E. Lawson Carl F. Berger Jane Butler Kahle

The Handbook of Research on Science Teaching and Learning, published by Macmillan in 1994, is a comprehensive survey of science education research that assesses the significance of the research, evaluates new developments and examines current conflicts, controversies and issues. The volume is presented in five parts: teaching, learning, problem solving, curriculum and context. An overview of the contents and a brief description of how the Handbook was conceptualized and produced will be presented by the editor. Authors of four of the nineteen chapters, each from a different section of the Handbook will then summarize the research review presented in their chapter and will give their view of the direction that research in their particular area might take in the future.

Gallagher, James J.

Strand 3 — Sat, 22 Apr, 1995 7:00 PM Nevada

Assessment Embedded in Science Teaching and Learning

Joyce Parker David Treagust Roberta Jacobowitz Janet Luallen
Greg Hill

This symposium focuses on how integrating assessment into science teaching affects teaching, learning and curriculum at the middle school level. Collaborating teachers and science education faculty will present case studies of the many facets of using assessment as an integral part of teaching. The audience will be asked to participate in the analysis of the data. The group will address such questions as the long term effects of assessment on teaching and students' learning and attitudes, the instructional decisions that are influenced by assessment, preparing students for their new role as active participants in learning and time management. The data come from two related projects. The first project is an in-depth study of the use of ongoing assessment in a three week unit on sound for 8th Graders. The second study is an NSF-funded project where middle school science teachers, university science educators and scientists are collaborating to understand assessment embedded in teaching. The group is building a picture of assessment that brings together classroom teachers' thinking on effective science teaching and their perceptions of the realities of today's classrooms with constructivist notions of understanding, learning and teaching and scientists' views of scientific literacy.

Gallard, Alejandro

Strand 4 — Sat, 22 Apr, 1995 7:00 PM Oregon

The Use of Videotapes and Practical Inquiry in Promoting Teacher Change

Bradford Lewis

Sixty-six middle grade science teachers, enrolled in a three-year teacher enhancement program, were asked to videotape themselves teaching two lessons. This, as part of a science education research course. Upon viewing their tapes many teachers began to question teaching practices that were previously regarded as strong. This questioning led over 90% of the teachers to develop research plans designed to help them understand and change their practice. In this study we explore the advantages of using self-analysis of videotapes to begin the process teacher change. We also explore the benefits of practical inquiry as a tool for teachers to understand and change practice.

Garcia-Bravo, William

Strand 9 — Mon, 24 Apr, 1995 4:00 PM Monterey

Ciencia, Educacion y Escuela: Un Enfoque Cultural

A través de investigación cualitativa con corninidades nativas andinas del suroccidente colombiano (paeces, totores y guambianos principalmente), viene realizandose un proceso de "reconstrucción" y "revaloración" cultural indígena. La investigación pedagógica de un equipo interdisciplinario de las ciencias sociales y naturales ha permitido vislumbrar y sustentar algunas consideraciones que deben impactar el trabajo escolar en cuanto a la enseñanza de las ciencias: El concocimiento, manejo y uso del medio ambiente por parte de las etnias está determinado por su historia y cultura ancestral - Las formas de protección, conservación de los recursos naturales son propias de cada cultura, es decir no universales - Se resalta la visión que algunas culturas tienen de la naturaleza y se compara con la occidental, asi como las formas de educación y comunicacion implicitas - Los fundamentos pedagógicos y comunicativos para una educación ambiental y enseñanza de las ciencias, deben establecerse a partir de la relación particular (local), hombre-sociedad-naturaleza, es decir la cultura e historia propias. El trabajo presenta la experiencia de diez años de investigación-capacitación, resaltando la elaboración de textos escolares culturales para la enseñanza de las ciencias naturales en escuelas indígenas. Por otra parte, la metodología de investigación-capacitación docente como un resurso metodológico que permite construir modelos educativos más apropiados a las condiciones socioculturales de las comunidades.

Gaskell, Jim

Strand 10 — Sun, 23 Apr, 1995 10:30 AM Crystal

Factors Affecting Student Choice of Career in Science: Gender Differences in Canadian Schools

Gaalen Erickson **Zhen Wang**

The Canadian component of the FASSIPES International project gathered data from 316 students in 14 secondary schools in different areas of British Columbia. Data about the students home and parental backgrounds, courses of study, career expectations and their reasons for and time of making career decisions were obtained. In addition data on their attitudes to science activities in school, the factors that encouraged them towards science and their perceived personality traits were also gathered. Distinct gender differences were noted in the students responses' both in regard of their background and ability and in their reaction to different types of science. This paper will outline the results from the Canadian study, with particular reference to the differences between male and female students.

Gattis, Kenneth W.

Strand 5 — Sat, 22 Apr, 1995 8:30 PM Emerald

Effectiveness of a Participatory Learning Program for College Students in High-risk Science and Mathematics Courses

Supplemental Instruction (SI) is a model for providing mentor-student and student-student interaction to assist learning in large high-risk college classes. Key elements in the SI program include the selection of competent self-motivated undergraduate students to service as "SI leaders" in the three weekly SI sessions; class attendance and session preparation by the leaders; the program's emphasis on indirect teaching techniques such as questioning and positive reinforcement; regular clinical supervision of the leaders by trained mentors; frequent instructor endorsements of the program and leader; and program evaluations such as user surveys and grade comparisons. This study evaluated a semester's grade performance of 3400 students in "SI" sections of chemistry, physics and math. 873 students voluntarily attended at least one SI session. Attendees' course grades were significantly higher than nonattendees (.41/four-pont scale, p=.0001), although their academic preparation as measured by SAT-Math was significantly lower (18 points, p=.0001). Academic Index, an admissions index chiefly composed of high school achievement, was virtually identical for the two groups. For attendees, there was a significant positive correlation between number of attendances and grade in the course (r=.19, p=.0001).

Gee, Carrie J.

Strand 3 — Mon, 24 Apr, 1995, 10:30 AM, Suite 2601

Examining the Content Knowledge, Pedagogical Knowledge and Pedagogical Content Knowledge of Preservice Elementary Science Teachers

Michael Svec J. Leonardo Sanchez Dorothy Gabel

The purpose of this research study was to determine whether students who selected science as their area of concentration for the undergraduate degree in elementary education know the appropriate science content, possess appropriate pedagogical knowledge and exhibit pedagogical content knowledge before their student teaching experience. Eleven research questions were developed to examine aspects of each type of knowledge that were specifically addressed in the teacher education program. Data from 15 students enrolled in a special interdisciplinary science course were collected in four ways: (1) a Likert Scale survey that assessed each of the three types of knowledge, (2) students' analyses of lesson plans containing correct and incorrect science content with appropriate and inappropriate pedagogical procedures, (3) a middle school field experience and, (4) laboratory exercises. A comparison group of students with other areas of concentration also completed the survey and the lesson plan analyses. Data were analyzed independently by four science educators. Results indicated that although the science area of concentration students were somewhat able to function theoretically within the three types of knowledge, they were unable to apply that knowledge adequately or appropriately in real-life teaching situations.

Gerber, Brian L.

Strand 5 — Sun, 23 Apr, 1995, 1:00 PM, Suite 2625

The Influence of an Interdisciplinary Program on Teachers' Attitudes and Understandings of Interrelationships between Energy, Environment and Public Policy

Ann M. Cavallo Edmund A. Marek John Chiodo

This study was conducted in the first two years of the Department of Energy sponsored project, *Energy, Environment and Policy Choices: Summer Institutes for Science and Social Teachers*.. Educators were involved in experientally-based two-week institutes that emphasized the interrelationships of energy, environment, economics and politics. This study examined the possible influence of the summer institutes on teachers' attitudes and opinions related to various energy and environment issues and on their understandings of interrelationships between energy, environment and policy choices. The teachers (N = 118) were pre and post tested on their attitudes toward energy issues using questionnaires from previous research and on their understandings of interrelationships between energy, environment and public policy. Results indicated that the teachers attitudes significantly shifted toward: (1) supporting technological development related to energy resources, (2) having greater confidence that government, industry and consumers were genuinely trying to solve energy problems and, (3) having diminished concern over the health and safety risks of certain energy resources. The teachers' understandings of the interrelationships between energy, environment and policy choices were enhanced such that they could formulate philosophical positions and make informed decisions regarding these issues.

Germann, Paul J.

Strand 5 — Sun, 23 Apr, 1995, 10:30 AM, Suite 2625

Empirical Analysis of Student Performance on the Tasks of Asking Questions, Identifying Variables and Formulating Hypotheses

A. Louis Odom

This descriptive study had two purposes. The first was to extend the work of Tamir, Nussinovitz and Friedler (1982) to develop a research framework for encoding and analyzing students' responses to the tasks of asking questions, identifying variables and formulating hypotheses. Second, the research framework was used to analyze and classify the responses of Grade 7 students to these tasks. A performance-based assessment instrument was used, the Alternative Assessment of Science Process Skills (AASPS). The topic was heat and temperature. The responses of 364 Seventh grade students who participated in a field test of the assessment were used to develop the Science Process Skills Inventory (SPSI), a framework for evaluating student written responses. The SPSI not only allows researchers to classify student responses according to their general completeness and usefulness, but also according to the manner in which responses were incomplete or not useful. Using this framework to encode student responses, interrater reliability was 82%. Seventh grade students who presumably have had instruction in the process skills did not perform well on this performance-based assessment; less than 50% of the students performed successfully on any skill. Recommendations for revision of the AASPS, classroom instruction and future study are discussed.

Gess-Newsome, Julie

Strand 3 — Sun, 23 Apr, 1995, 8:30 AM, Carmel

The Influence of Curriculum Development on Teachers' Representations of Subject Matter Structure

The purpose of this research was to experimentally document the influence of curriculum development work on science teachers' representations of the subject matter they teach. Eighteen secondary science teachers met for eight days of curriculum training and writing, including specific training in the use of the Benchmarks. Pre and post open-ended questionnaires were compared to a matched sample of non-writers. Five teachers from each group were selected for follow-up interviews. All the writers (100%) described their subject matter structure (SMS) of science as integrated in comparison to 45% of the control teachers. This difference was attributed to reading the Benchmarks. Curriculum writing caused teachers to refine their SMS, particularly in the area of content integration and ideas for classroom implementation. These findings suggest the potential benefits of all teachers receiving training in the use of the Benchmarks and participating in opportunities to incorporate national reforms into their classroom practice. Further research is needed in the translation of this knowledge into classroom practice.

Gibson, Adrienne

Strand 10 — Mon, 24 Apr, 1995 10:30 AM Portola

A Synopsis of Methodology: Student Worldviews

Scott Underwood William Cobern

Americans tend to assume that science is a natural part of students' culture. There is, however, widespread disinterest in science. American society is increasingly pluralistic and there are several cultural subgroups traditionally underrepresented in science. A new approach is for American science educators to consider the possibility that science is a second culture experience for many students. We thus suggest it is important for science educators to understand the fundamental, culturally based beliefs about the world that students bring to class, and how these beliefs are supported by students' cultures; because, science education is successful only to the extent that science can find a niche in the cognitive *and* socio-cultural milieu of students. Reported here are newly developed ethnographic methods involving semi-structured interviews with elicitation devices based on categories derived from worldview. The interviewer, consistent with Spradley (1979) and Kvale (1983), asks probing questions and encourages the student to speak freely and at length. The interviews are audiotape, transcribed and coded. The coded transcriptions are used to map the qualitatively different conceptualizations of nature, relationship to nature, classification of nature, and causality. This type of research suggests a different view of scientific literacy which is examined in the report.

Giddings, Geoffrey J.

Strand 2 — Mon, 24 Apr, 1995 4:00 PM Washington

Motivational Patterns and Instructional Strategies in Science Classrooms in Australian Schools

Bruce G. Waldrip

This paper describes: (1) the adaptation and development of two instruments for assessing students' motivational profiles and preferred instructional strategies, (2) reports comprehensive validation information for a sample of 1500 junior and senior high school students in Australian Science classrooms across a range of subjects (General Science, Biology, Physics), and (3) reports several findings from these studies relating to the link between motivational profiles of students and their preferred instructional strategies. Distribution of students across grades, gender and subjects according to their motivational profile were determined for both samples of students. A regression technique was used to probe the relationship between students' motivational traits and their preferences for various instructional strategies. Over half (54%) of the students tested revealed a motivational profile dominated by one (31%) or two (23%) traits. Some of the motivational profiles varied remarkably from Grade 8 through to Grade 11. An examination of motivational traits by gender, revealed a consistent pattern across schools and subjects. The study confirmed the validity and reliability of the motivational scales and the instructional inventory in the setting of Australian schools.

Gilmer, Penny

Strand 3 — Mon, 24 Apr, 1995 10:30 AM Suite 2601

Bridging the Gap between the Beliefs and Practices of College Biology Teachers and the Science-related Needs of Prospective Elementary Teachers

Hedy Moscovici Sue Mattson Kenneth Tobin

This investigation studies the teaching and learning in a course that was designed to meet the needs of prospective elementary teachers. The study focused on the teaching and associated learning by a college Biology Professor with several teaching awards who typically teaches Biology majors. His teaching methods were based on lecturing, coupled with some innovative laboratories. He did not address students' prior knowledge or their motivation to learn. The students were afraid to communicate what they did not understand because of the power that the professor had on their grades and because of a fear of "looking stupid". The study suggests that problems can occur when teachers do not take account of the goals of learners when they plan, implement and assess student performance in a course designed for prospective elementary teachers. Close attention needs to be directed toward the role of discourse in bridging the gap between the extant knowledge of students and the understandings intended by the instructor. Special attention needs to be given toward the problems these students have in making sense of science.

Ginns, Ian

Strand 4 — Sat, 22 Apr, 1995 8:30 PM Emerald

Preservice Teachers' Performance on a Projectile Motion Teaching Sequence: Research into Practice

James Watters

The purpose of the study was to analyze the effects of the implementation of a teaching sequence on preservice elementary teachers' understandings of projectile motion. The structure of the teaching sequence, based on previous research findings, comprised a series of pen-and-paper and video clip projectile motion problems. The sequence was punctuated with flexible time intervals which enabled students to predict possible outcomes associated with each problem, explain their reasons for making relevant predictions, and finally, to review and reflect on each stage of the learning experience. Implementation of the teaching sequence occurred within the typical constraints of any university course. The results indicated that most student's understandings of projectile motion changed during engagement in the teaching sequence. This effect was particularly noticeable with students who initially held naive views of projectile motion. The implications of the results for preservice teacher education are examined.

Ginossar, Shlomit

Strand 1 — Sun, 23 Apr, 1995, 8:30 AM, Redwood

Withdrawing the Taboo Regarding Anthropomorphism and Teleology in Biology Education: Heretical Suggestions

Anat Zohar

Biology educators are often concerned that teleological and anthropomorphism (TEL/ANT) formulations may confuse students by supplanting explanations in terms of causal mechanisms. The purpose of this study was to investigate the impact of a biology textbook that contains numerous (TEL/ANT) formulations. This textbook was used in six experimental Grade 11 classes. Four additional classes were selected as a comparison group. Altogether, 142 students participated in this study. The results indicate that the use of a (TEL/ANT) textbook is not followed by an increase in students' application of (TEL/ANT) formulations and/or explanations. Students' reflections upon their own learning processes testify that (TEL/ANT) formulations do indeed have heuristic value. This study, therefore, shows that allowing the use of (TEL/ANT) formulations, may indeed have pedagogical value, with no necessary risk to students' accurate scientific thinking. It is suggested that (TEL/ANT) formulations can become a legitimate part of Biology education.

Glick, Judith G.

Strand 6 — Tue, 25 Apr, 1995, 1:00 PM, Suite 2601

A Profile of Undergraduate Women Considering Graduate Study in Science

An open-ended survey was used to identify critical attributes of female undergraduates who are considering graduate study in science. Eighty-two completed surveys were analyzed using qualitative techniques. Most of the women received encouragement from family, friends or faculty, but very little guidance is actually available to these women. The need for mentors is implied and actually stated. About 2/5 of them did not decide to study science until after high school, indicating that talented women can be recruited into the sciences during college years. Respondents have a realistic view of the gender-neutral rewards and challenges associated with scientific research careers. Challenges specific to women are balancing family and career and being a women in a male dominated field. Rewards for women were the ability to be a role model for other women and to know you have achieved despite the barriers that exist for women.

Goldberg, Fred

Strand 1 — Sun, 23 Apr, 1995, 10:30 AM, Portola

Intermediate States and Powerful Ideas: Learning about Image Formation

Sharon Bendall

Through prior research we have identified some potential intermediate states of learning that could facilitate students' understanding of the entire image formation process. We have incorporated these states into a conceptual model of geometrical optics that we help students develop in a physics course for prospective elementary teachers. The model consists of a set of powerful ideas that are verbal and diagrammatic representations of formal physics ideas. Classroom activities to help promote development of the model include working with locally developed interactive multimedia programs and the writing and collaborative peer evaluation of comprehensive explanations of novel phenomena. The computer programs encourage meaningful conversations between students and enable students to represent their ongoing ideas about light symbolically on the screen. The writing/evaluation activities seem to help students make connections between ideas and promote the critical evaluation of alternative ideas. The total learning environment has resulted in significant gains in students' ability to explain novel optical phenomena in terms of the powerful ideas.

Good, Ron

Strand 10 — Sat, 22 Apr, 1995, 7:00 PM, Crystal

Project 2061 Research Blueprint

Charles Anderson, Kathleen Fisher, Dorothy Gabel, Larry Yore, Norman Lederman, James Shymansky, James Wandersee

At a two-day meeting (April 8-9, 1994) in New Orleans 25 science educators, mathematics educators, social studies educators and Project 2061 staff met to discuss the proposed Research Blueprint. The Research Blueprint is intended to identify and encourage systematic inquiry needed to ensure informed decision making that will lead to the kind of science literacy for all Americans envisioned by Project 2061. This symposium will involve the panel members and the audience in discussions of current actions and proposed plans related to the Research Blueprint and implications of coordinated, interdisciplinary research efforts for NARST.

Grewal, Joe

Strand 7 | Tue, 25 Apr, 1995 8:30 AM Portola

Exploring the Potential of Multimedia in Teaching Intermediate Science

Pierce Farragher

This study was an investigation of the potential of multimedia in improving the teaching and learning environment of an intermediate science class. The control group had the unit of instruction presented via traditional teaching methods including lecture, demonstration, lab work and group activities. The experimental group was presented with the same unit using a multimedia approach. The multimedia consisted of an interactive video system (IV), a computer, a liquid crystal display (LCD), an overhead projector and a Hypertext authoring tool called HyperCard. This study showed that it is possible to impact student attitudes towards science in a positive manner through the use of multimedia and IV. The students found the visual nature of the use of multimedia presentations very appealing. The instructor found this method of instruction to be a valuable resource in motivating students to learn. He found that the visuals were especially useful in stimulating students to ask questions, participate in class discussions and to reinforce concepts presented in class. While the use of multimedia resulted in more positive student attitudes, it did not produce significantly greater achievement gains.

Griffin, Janette

Strand 10 | Sat, 22 Apr, 1995 7:00 PM Suite 2625

School-Museum Learning: Integrating New Approaches

Museums and science centres are recognized as powerful learning environments. A preliminary study in Australia indicated, however, that structures imposed by teachers on school-museum visits impeded learning. Neither teachers nor students exhibited clear understanding of the purposes, uses or benefits of museums as learning environments. These results were integrated with research findings on children's learning in science, exemplary teaching practices and "natural" learning behaviours in museums, to develop learning approaches for "formal" groups in informal settings. Trials with elementary grades indicate a substantial change in attitudes and learning by students and new insights to learning in informal settings by teachers.

Griffiths, Alan

Strand 1 | Sun, 23 Apr, 1995 2:45 PM Nevada

High School Students' Views about the Meaning of Technology

Nancy Parsons-Heath

A representative sample of 26 high school students were interviewed individually to determine their understanding of the meaning of technology and of differences between science and technology. Questions solicited students' knowledge of examples of science and technology; their knowledge of activities associated with each of these fields and the purposes of each; relationships between science, technology and society; characteristics of scientists and technologists and students' sources of information about each field. Although most students had a good understanding of the general purposes of both science and technology, they were less clear about differences between the products of these fields. Most of the students believed erroneously either that, without science, technology would not exist or that science and technology were one and the same thing. Students' stereotypes of typical scientists were similar to those identified elsewhere in the literature, but no consistent view of technologists was proposed. Students believed in a democratic model of decision making with respect to issues relating to the application of science and technology in everyday life.

Grimes, Katheryn

Strand 10 | Tue, 25 Apr, 1995 1:00 PM Emerald

The Influence of a Constructivist-based Elementary Science Curriculum on At-risk Students

Richard R. Powell

This study explored how a constructivist - based elementary science curriculum, which was called Science Museum and Instructional Laboratory for the Environment (SMILE), fostered at-risk students' personal construction of science knowledge and how this construction affected students' self-worth and personal autonomy for learning science. Conducted over an entire school year and using participant observation and case study methods, data were gathered from seventeen at-risk Grade 5 students who actively participated in SMILE. Data, which consisted of classroom observations, student interviews, field notes and reflective journals maintained by the researchers, were analyzed using the constant comparative method. Five themes emerged during data analysis: participation in science activities, students-as-science-teachers, student self-worth, student autonomy in learning science and student empowerment. From these themes a set of working hypotheses were developed and implications for developing constructivist elementary science curricula were drawn.

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Grynkewich, Linda C.

Strand 2 — Sun, 23 Apr, 1995 2:45 PM Oregon

A Study of the Relationships Between Student Learning Style and Performance in Introductory College Chemistry

Ronald Simpson Darwin Smith

The purpose of this study was to explore the relationships between student learning style as measured by the Hanson & Silver Learning Style Inventory and the performance of students majoring in science or science-related areas while enrolled in introductory college chemistry. The study was both qualitative and quantitative in nature. The qualitative aspect consisted of a case study and a follow-up study. The quantitative aspect involved 176 participants. There was a significant difference at the .0001 level between the performance of different types of learners. There was also a significant difference between the performance of "feeling" students and "thinking" students. The qualitative interviews delve into the identification of how students with particular learning styles perceive this phenomenon. The implications included that learning style theory could shed light upon the more than 40% attrition rate between the freshman and sophomore years for students majoring in the sciences.

Guo, Chorng-Jee

Strand 3 — Sat, 22 Apr, 1995 8:30 PM Emerald

Practicability of Constructivist Approaches in Science Teaching: A Case Study of Six Science Teachers in Taiwan

Wu-Hsiung Chiang Mei-Ling Chen Chun-Yuan Wang

Practicability of constructivist approaches in science teaching was studied, based on qualitative data obtained from case records of six science teachers participating in a cooperative research study. The data sources included written documents, interviews, recordings of research group meetings, and classroom observations. Results from this study indicated that science teachers tended to hold to their own beliefs and matters of concerns and were willing to use constructivist approaches only electively. It was noted that considerable effort must be made in order for science teachers to develop a better understanding of and belief in constructivism and to be familiar with a variety of pertinent instructional strategies. The practicability and effectiveness of constructivist teaching were found to be influenced by factors such as students' study skills, evaluation system and school and parents' supports for and faith in the science teachers. Finally, implications of the research findings to science teacher education were also discussed.

Gustafson, Brenda J.

Strand 4 — Sun, 23 Apr, 1995 4:00 PM Redwood

An Exploration of the Interplay between Preservice Teachers' Existing Science Knowledge and Constructivist Instructional Strategies

Patricia M. Rowell

The purpose of this study was to explore the question: How can we help elementary preservice teachers develop their understanding of conceptual science in a way in which their existing knowledge is valued and included in the instructional strategies? The 85 preservice teachers participated in a four to five week (three hours per week) course experience in either Weather or Electricity. Study data were assembled from two surveys, daily written reflections, examination questions and semi-structured interviews. Participants identified a number of obstacles to meaningful learning which related to the influence of their existing knowledge upon learning public science. We present these obstacles and discuss how instructors of science curriculum courses might respond to the challenge of scaffolding inquiry into subject matter content.

Guy, Mark

Strand 3 — Sun, 23 Apr, 1995 4:00 PM Suite 2601

Preservice and Inservice Elementary Teachers' Classroom Experiences with Science/Mathematics Integration

Mavis Kelley

The purpose of the study was to investigate the process of implementing science/mathematics integration from the perspectives of preservice and inservice elementary teachers. Teacher perceptions of what made a difference during the classroom implementation process were of primary importance. Two preservice elementary teachers were paired with two elementary classroom teachers. Over a three month period, each preservice/inservice teaching pair planned a three to four week integrated science/mathematics experience for the classroom. Sources of data for the study included: teacher journal, classroom observations and audio-taped teacher interviews at the end of the integration experience. The findings indicated that conceptual depth and conceptual connectedness of the science/mathematics integration were closely associated with teacher conceptions of the nature of science and mathematics as related to curriculum. Teaching experience and familiarity with local curriculum were less powerful influences.

Haack, Constance

Strand 1 — Sat, 22 Apr, 1995 8:30 PM Emerald

Textbook and Laboratory Centered Lessons: The Relationship to Development and Use of Scientific Models

The purpose of this study was to examine the ways in which high school students developed and used scientific models related to kinematics and Newton's laws. Four students engaged in a two-week session in which the lessons were textbook centered and in a two-week session in which the lessons were laboratory centered. Students showed a greater tendency to relate problems to concrete models during the laboratory centered lessons. In both cases the students generally tried to find a formula to fit the given variables.

Hackling, Mark W.

Strand 1 — Mon, 24 Apr, 1995 8:30 AM Nevada

The Development of Science Investigation Skills through Elementary, Secondary and Tertiary Science Education

Patrick J. Garnett

This paper reports on a study that compares the performance of Australian elementary, junior and senior high school students, university students and expert research scientists on a practical, laboratory-based, science investigation task. Data revealed limitations in the work of the school students and provided insights into the development and nature of expertise in science investigation skills. Recommendations are made for modification of school and university laboratory work to more effectively develop expertise in science investigation skills.

Hagelin, Linda B.

Strand 1 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Student Understanding of Selected Science Concepts Related to Water

Karen Reynolds

Recent findings regarding the understanding of how students learn concepts in science have revealed a high occurrence and persistence of misconceptions that students bring into the science classroom. The purpose of this study was to explore and document patterns of student understanding of science concepts dealing with water, particularly in predicting behavior and interpreting observations of two water solutions of different density. Students from the fourth, sixth and eighth grades were given a paper and pencil assessment test accompanied by a video taped demonstration. The test asked for explanations of the students' ideas in their own words. The results of this test indicate differences in student ideas, which characterized each grade level studied, about the behavior of two water solutions of different weight or density. Classroom implications are presented that indicate the importance of teacher recognition of the ideas students bring into the classroom. In addition, the effectiveness of a video based assessment instrument was demonstrated.

Hallenbeck, Mark J.

Strand 1 — Mon, 24 Apr, 1995 8:30 AM Oregon

Integrating Science and Literacy: An All-School Focus on Oral Discourse Language

Edward L. Smith

This presentation is based on work being carried out in a Professional Development School, an elementary school in which teachers and university faculty and graduate students collaborate in on-going projects over a period of years. After three years of exploration, the focus was redefined as the integration of science and literacy with an emphasis on oral discourse. Drawing on relevant literature, classroom practice and reflection on our own conversations about science phenomena, we identified a set of oral discourse 'components' such as making claims, supporting claims with reasons and evidence, asking clarifying questions and encouraging others' contributions. Teachers attempted to address these components in units related to the theme 'Changes in Matter.' We developed an approach involving video taping of small group problems solving activities as a basis for assessing children's oral discourse competence. Teaching strategies that could enhance use of literacy components and the quality of discourse were identified.

Halloun, Ibrahim A.

Strand 1 — Mon, 24 Apr, 1995 8:30 AM Oregon

Modeling Instruction in Physics

Models occupy the content core of physics, and modeling is a major process for constructing and employing physics knowledge. A model is characterized by its domain, content, environment, structure and organization. Problem solving is a schematic modeling process consisting of model section, construction, validation, analysis and deployment. High school and college students who were trained in the US and Lebanon to follow a modeling approach for solving mechanics problems were significantly: (a) better problem solvers than their control peers, (b) more successful in changing their lay conceptions abut the motion of physical objects, and (c) higher achievers in their formal physics courses.

Hameyer, Uwe

Strand 1 — Sun, 23 Apr, 1995 4:00 PM Oregon

Performance Assessment of Higher Order Thinking Skills in Elementary School Science: What Do We Measure?

Jürgen Baumert Robert H. Evans

A constructivist perspective suggests a revision of current assessment technology to include the direct assessment of complex performance through such means as portfolios, open-ended questions and hands-on experiments. This study helps to clarify just what such performance items are actually measuring. We used a detailed process analysis of items designed to assess higher order thinking skills to identify several subprocesses in the performance tasks which would require similar as well as dissimilar abilities for solution. It was found that a general factor model did not fit the data and that the skills covered by the subtask were confounded with the task-shells. Our performance tasks measured different things than science achievement items and did not converge with complex problem solving tasks. Serious reliability problems were created by variability between subtasks and tasks. The results showed that the main problem lies in the complexity of the demands of authentic performance tasks. The subtasks seem to be embedded into the specific task-shells so that they are hardly transferable.

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Hamid, Mohd L.

Strand 4 — Tue, 25 Apr, 1995 1:00 PM Nevada

Malaysian Student Teachers' Conception of the Nature of Science

Zurida Ismail

The purpose of this study was to investigate the preservice secondary school teachers' views and beliefs about the nature of science through their operative definitions of science. Seventy-eight participants were involved in the qualitative study. Results indicated that the preservice teachers have an incomplete view of the nature of science and are insecure about the suggested teaching strategies as well as the science process skills or the scientific method itself.

Hammond, Roselyn Brown

Strand 1 — Mon, 24 Apr, 1995 2:30 PM Nevada

Educating in a Biology Classroom: A Coherent Approach to Teaching, Curriculum, Learning and Governance

A descriptive case study approach was used in examining the commonplaces of curriculum, teaching, learning and governance in two sections of a freshman college Biology course. *Vee analysis, concept mapping and interviews along with numerous other techniques* were used. The research was based on Gowin's *Theory of Educating, Novak's Theory of Meaningful Concept Learning and the Ausubel/Novak Theory of Cognitive Assimilation Learning*. Vee Analysis was used to select and logically arrange the curriculum based on the theories, to prepare lesson plans and to evaluate learning. Basic concepts of Biology were identified using Vee analysis of the disciplines and often using Primary source materials. Vee analysis and concept mapping were routinely used by students to help them learn concepts and to enable them to gain insights into their own learning and self-governance. The study was conducted for a period of one semester. The usefulness of the techniques, as well as the applicability of the theories were effectively demonstrated.

Haney, Jodi J.

Strand 3 — Sun, 23 Apr, 1995 2:45 PM Redwood

The Determinants of Ohio Teachers' Intentions to Implement the State Science Model into Their Classroom Instruction

The purpose of this study was to determine the factors influencing Ohio teachers' intentions to implement the four strands of the Ohio Science Model (inquiry, knowledge, conditions and applications) into their classroom instruction. Ajzen and Madden's (1985) Theory of Planned Behaviour was used to examine the influence of three primary constructs (attitude toward the behaviour, subjective norm and perceived behavioural control) on teachers; intentions to engage in the targeted behaviours. The teachers' salient beliefs for each of the primary constructs were further examined to determine their degree of contribution. Differences between various teacher populations for both intent and the three primary constructs were also investigated. The data were obtained using survey research (N = 800) Ohio teachers, randomly selected and stratified by grade level and state region). Backward solution multiple regression and ANOVA techniques were used for statistical analyses. Results indicated that the attitude toward the behaviour construct held the greatest influence on Ohio teachers' intent to implement all four strands of the science model; several salient beliefs for each of the three constructs significantly contribute to the constructs; and significant differences exist between various teacher populations for both intent and the three constructs.

Harrison, Allan G.

Strand 1 — Tue, 25 Apr, 1995 8:30 AM Oregon

Changing Student Understanding of and Attitudes to Physics during the Learning of Heat and Temperature Using an Inquiry Approach

Diane Grayson

This paper describes the cognitive and effective changes to student thinking that occurred during a Grade 11 study of heat and temperature. The instruction utilised an inquiry approach coupled with concept substitution strategies aimed at restructuring alternative conceptions identified using pretests. Constructivist stances were employed in both the teaching and the research. Qualitative data in the form of frequent teaching transcripts, complete student portfolios including concept maps plus teacher/researcher observations and reflections were collected and interpreted to generate student case studies. In depth examination of the students' prior, formative and final conceptions showed that during this unit the students accepted greater responsibility for their learning, were willing to take cognitive risks and became more rigorous and critical in both written and verbal problem solving. The students' initial conceptual frameworks were undifferentiated with respect to heat and temperature. The course's activities and concomitant use of concept substitution differentiated these concepts and integrated them into a more acceptable form in a significant number of cases. A number of students also demonstrated affective and epistemological changes.

Harrison, Christine

Strand 4 — Mon, 24 Apr, 1995 10:30 AM Gold Rush II

Developing an Inset Culture in Nigerian Colleges of Education

This paper examines the constraints, compromises and successes in fostering an Inservice teacher education (INSET) culture within and between Integrated Science departments in Colleges of Education in the northern part of Nigeria. These colleges have been involved in a five year funded initiative designed to improve the teaching of science at Junior Secondary level and delivered by enhancing the skills and knowledge of the lectures who train the science teachers. Some of the factors which influence how the skills and information are spread through the college departments and how these reach the existing teaching profession will be considered in detail. An important facet of this work hinges on strategies which engender sustainability and this suggests that an important step in ensuring project continuation beyond its funding stage is the development of a shared Inset culture within a participating establishment.

Haury, David L.

Strand 2 — Mon, 24 Apr, 1995, 4:00 PM, Suite 2601

Study of a Field-developed Model of Scientific Inquiry

A simple model of scientific inquiry was developed using non-technical language. One group of elementary school teachers was introduced to the model during a two-week summer institute where the model was used in conjunction with activity-based approaches to teaching. Participants applied the model in planning and facilitating activities for children enrolled in a summer camp. Another group of teachers was introduced to the model during a series of workshops for teachers and principals. The model was introduced as the central heuristic for designing and developing science lessons and units of study. A survey was conducted two years after the most recent summer institute. The purpose of the survey was to determine: (1) the extent to which the model was understood, (2) the degree to which it was being used to plan and implement instructions, and (3) the extent to which it facilitates desired effects among students. Survey results provide evidence that; (1) the model is well understood by most teachers and facilitates an understanding of the nature of inquiry, (2) the model facilitates and activity-based, inquiry-oriented approach to science teaching, and (3) teachers report that students are reacting favourably to instruction based on the model.

Häussler, Peter

Strand 6 — Mon, 24 Apr, 1995, 2:30 PM, Suite 2601

An Intervention Study to Enhance Interest and Performance of Girls in Physics Classes

Lore Hoffman

Particularly in the so called "hard" science subjects the supposedly equal treatment offered by coeducation in schools proves to be, on closed inspection, an extremely subtle form of unequal treatment. The syllabus and the modes of behavior of both male and female teachers are mainly influenced by the interests, knowledge and abilities of the boys. An intervention project aimed at giving girls a better chance in science was carried out focusing on the initial courses of Physics on secondary level I (Grade 7). Three aspects of innovation were involved: (1) development of new teaching units and materials based on empirical results on the specific interests, experiences and abilities of girls, (2) development of strategies to check ones' own (teacher's) classroom behavior and, (3) alternating single sex with coeducational teaching vs. coeducational teaching only. The effects of the intervention measures are evaluated in a longitudinal design. Gender specific differences in interest and achievement in physics will be discussed depending on personality characteristics and classroom characteristics as well as the developed curriculum and its motivational impact.

Hayes, Michael T.

Strand 5 — Mon, 24 Apr, 1995, 2:30 PM, Monterey

Curriculum in Conflict: Ideology and the Differentiation of Classroom Science Knowledge

This research investigated the relationship between the science curriculum, ideology and differentiated classroom science knowledge in four classrooms situated in schools with very different student demographics. The curriculum, which includes written materials, teachers' pedagogical content knowledge and pedagogical knowledge, was investigated using naturalistic ethnographic methods. The results from this study suggest that the link between ideology and a differentiated science curriculum is much more complex and contradictory than previously suggested. While the curriculum was differentiated based on the ethnic and socio-economic composition of students in the school, there were a range of conflicting ideologies reflected in those curricula. Teachers are aware of, and juggle numerous ideologies, such as social control and participatory democratic, as they prepare the curriculum for their students and present it during classroom activities. The result is a science curriculum that represents schooling's historical development as organizations of social control, as well as institutions devoted to democratic ideals.

Hazelwood, Constanza

Strand 9 — Mon, 24 Apr, 1995, 4:00 PM, Monterey

Hablando Sobre Ciencias: Perspectivas de Hispanas Sobre Identidad, Ciencia Escolar y el Conocimiento Cientifico

El propósito de este estudio fué explorar el problema de la participación en la ciencia escolar desde la perspectiva de un grupo de adolescentes de origen Hispano. Las participantes fueron seleccionadas con base en diversos criterios: su origen étnico, sexo, edad y vinculación con las escuela. Las experiencias de estas Jóvenes fueron articuladas de forma oral durante entrevistas, diálogos y conversaciones entre las participantes y la investigadora principal. Algunas participantes se expresaron en forma escrita a través de diarios. La colección de relatos que sirve como foco de discusión y análisis de este articulo, dirige nuestra atención hacia las formas de identidad uq facilitan o impiden el acceso al conocimiento cientifico y a la participación en la ciencia escolar.

Hazelwood, Constanza

Strand 9 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

Talking about Science: Perspectives of Hispanics about Identity, School Science and Scientific Knowledge

English presentation of the topic above.

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Hedgepeth, David J.

Strand 1 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

A Comparison Study of the Learning Cycle and a Traditional Instructional Sequence in Teaching an Eighth Grade Science Topic

Dennis W. Sunal

The purpose of this study was to compare student learning in two different types of instruction. Three eighth grade classroom teachers and 180 students participated in one school setting. Each teacher taught a unit on the same topic, "weather", in two different ways: the learning cycle, and a traditional textbook approach. Teachers were given training on the learning cycle approach and were provided with lesson plans which were designed to be consistent with conceptual change theories. The classes were monitored to determine whether different classes were receiving different forms of instruction. Students were given pre- and post- tests on content knowledge, textbook chapter tests and developmental tests to determine whether they were concrete, formal or transitional learners. Student interviews and extensive classroom observations also provided a qualitative component of data. The results indicate that students learn differently in the two instructional formats and the two are not equivalent. Students who were able to answer questions regarding concepts during interviews may still not do well on literal tests. Also, the teachers who had less experience in teaching earth science topics had more difficulty in applying the learning cycle/conceptual change model.

Helms, Jenifer V.

Strand 8 — Tue, 25 Apr, 1995, 8:30 AM, California

What's so Special about Science? How Six Secondary Science Teachers View the Nature of Science

This study explores six experienced high school science teachers' perspectives on contemporary issues about the nature of science and their meaning for science instruction. Over the course of eight months, the teachers acted as a "critical community"— reading, discussing and critiquing selected works from the current science studies literature in light of their teaching. I investigated how their views about the nature of science took shape within a collaborative group setting and what curricular materials they produced based on their readings and conversations. Preliminary analysis of the data reveal that their discussions invariably cycled back to the problem of demarcations: what's so special about science? Discussion of topics such as, the role of science related social issues in science, the extent to which gender makes a significant difference in the doing of science, whether or not the scientific method exists and the nature of scientific progress, helped the teachers clarify for themselves, what they felt made science stand out from other disciplines. In this paper, I describe how this issue of defining the "essence" of science evolved in the teachers' conversations and their classroom practice.

Henderson, David G.

Strand 2 — Mon, 24 Apr, 1995, 10:30 AM, Nevada

Gender Differences in Biology Students' Perceptions of Actual and Preferred Learning Environments

Darrell L. Fisher Barry J. Fraser

This study of senior high school Biology students investigated gender differences in students' perceptions of actual and preferred classroom and laboratory learning environments, as measured by the *Questionnaire on Teacher Interaction* (QTI) and the *Science Laboratory Environment Inventory* (SLEI). Also magnitudes of the gender differences in learning environment perceptions were compared with those in students' cognitive achievement, practical performance and attitudinal outcomes. The 489 students in 28 Biology classes responded to the actual and ideal forms of the QTI and the actual and preferred forms of the SLEI. Student attitudes were assessed with scales adapted from the Test Of Science-related Attitudes. Each student's performance on the end-of-year examination was used as a measure of cognitive achievement and practical tests based on the *Practical Test Assessment Inventory* were used as a measure of students' practical skills. Gender differences were investigated using a series of one-way multivariate analyses. Results of previous studies were replicated in that female students were found to perceive a more positive learning environment than did males, but gender differences were not apparent in any of the three outcome measures.

Henning, Elizabeth

Strand 2 — Sun, 23 Apr, 1995, 8:30 AM, Oregon

A Vygotskian Perspective on Discourse in a Seventh Grade Science Class in an Urban South African School

Johan Strauss

The research reported in this paper was aimed at analysing classroom discourse from a Vygotskian-Bakhtinian perspective. A Grade 7 Science class was observed and fieldnoted over a six month period and the video recorded lesson referred to in detail was recorded mid-way through this time. The school is a state school which is situated in a previously segregated urban living area (Soweto) where mostly Black South Africans reside. The teacher holds a degree and a diploma in education and she and the students speak English as a third or fourth language. The analysis of classroom discourse revealed distinct regularities as well as some discrepant items. The most pervasive of the recurring discourse events was the teacher's own register of scientific concepts which was flexible and not decontextualised. She was not rigidly formalised in her management of classroom discourse and appeared to venture beyond what Wertsch (1993) describes as "sign, type-sign type relationships" of literal meanings. As an African woman, she showed sufficient sensitivity to the socio-cultural discourse needs of the students and allowed for a perspective of life history and societal influence to be accommodated in the lesson, which otherwise proceeded mostly linearly.

Henson, Stanley J.

Strand 4 — Tue, 25 Apr, 1995, 1:00 PM, Emerald

The Relationship between Preservice Elementary Science Teachers' Efficacy and Methods of Instruction during Student Teaching

The purpose of this study was to investigate relationships between preservice elementary teachers efficacy belief that science learning can be influenced by effective teaching and by their own self efficacy using three teaching methods. The 34 participants were given the Efficacy Belief Instrument for Elementary Science Teachers and were asked to rate themselves on their ability to teach science by three teaching methods, PET, Inquiry and Advance Organizers. The participants were administered the instruments before and after their twelve weeks of student teaching. The Pearson correlation coefficients were used to find any significant relationships. Results indicate significance of efficacy belief that the effective use of inquiry could influence science learning at the beginning of their student teaching. Post evaluation results indicated the use of Advanced Organizers caused student teachers to be more confident in teaching science rather than the use of the inquiry or PET (Madeline Hunter) methods of teaching.

Hestenes, David

Strand 8 — Tue, 25 Apr, 1995, 8:30 AM, California

Schematic Structure of Scientific Concepts: The Case of Physics

Ibrahim A. Halloun

Schematism is proposed as an epistempological framework for describing the structure of knowledge in various sciences. Accordingly, a concept may be comprehensively defined in a scientific theory by a generic set of descriptors that includes: (1) *correspondence rules* which determine what the concept can represent, (2)*associations* which relate this particular concept to other concepts, (3) *quantification laws* and *rules* which establish how the concept can be measured and operated with, (4) *semantic rules* which state how the concept can be communicated and interpreted, and(5) *application rules* which regulate how the concept can be employed in constructing and using scientific knowledge. The concept of force is presented accordingly for illustration.

Hewson, Peter W.

Strand 1 — Mon, 24 Apr, 1995, 10:30 AM, Redwood

Teaching with Students' Ideas in Mind

Beverley Bell **Nella Grimellini-Tomasini** **Gertrude Hennessey** **Aletta Zietsman**

This interactive symposium addresses the question: How should teaching adapt in order to take account of students' ideas, students' thinking? Its goal will be to develop, if possible, areas of consensus in the process of answering the question. As many people have investigated the implications of the diversity of students' ideas and way of thinking, several issues have emerged as being significant indicators of teaching change. These include teacher and student roles, teaching sequences, student metacognition and the nature of the curriculum. While at some levels there is a degree of unanimity about the significance of these issues, at other levels much still remains to be done to explore their implications. The symposium participants have all conducted research in this area, although from different perspectives, at different grade levels and in different content areas.

Hildebrand, Gaell

Strand 6 — Sun, 23 Apr, 1995, 8:30 AM, Suite 2601

Reviewing Gender and Science Education via Multiple Frames of Reference

This paper uses a metaphor, that of spectacle frames, to contend that multiple "frames of reference" can be employed to examine gender and science education research. When using alternative frames of reference the same objects, incidents or practices will be perceived, interpreted and constructed differently. This paper maps the shifting patterns of research over the last fifteen years re/viewing them through the following three sets of feminist lenses: access and equity (linked with liberal feminism); inclusiveness and valuing girls' women's experience (drawing on radical feminism); and critically examining and challenging the paradigms (using the tools from postmodern and post-structural feminisms). For example, research undertaken from the first frame of reference, which appears to be the most common and the view selected by most new workers in the field, takes the "malestream" as both the measuring stick and the goal. Examples of research which use each frame of reference are re/viewed. The contention is that no one perspective is "right" in all contexts, for all people, and that deliberately locating oneself in an alternative frame of reference enables new issues, strategies and dilemmas to be viewed.

Hobden, Paul

Strand 2 — Tue, 25 Apr, 1995, 8:30 AM, Nevada

The Role of Routine Problem Tasks in the Teaching of Physical Science

The purpose of this study was to develop an understanding of the role and context of routine problem solving tasks from multiple perspectives. The study is based on observations of two teachers over a period of a year. During this period over 120 classroom visits were made. Data collected included fieldnotes, interviews with the examiners, teachers and students, classroom documents and extensive audio and selected video records. A description of the classroom context and an analysis of the type of problem tasks is made. An interpretation of the meaning attached to these routine problem tasks from various perspectives is given showing that teachers and students have different understandings. It is also found that practice on routine problem tasks does not prepare students for the non-routine problems encountered in tests. Implications of the study are that educators must create new types of problem tasks and different learning contexts if their students are to be concerned with sense making and not with mastery of facts and algorithms.

Hoffmann, Lore

Strand 6 — Mon, 24 Apr, 1995 2:30 PM Suite 2601

Assessment of Students' Interest in Physics as a Means of Improving Instruction

Peter Häussler

Many studies show that students' interest in physics instruction decreases during secondary school and that girls are less interested in physics than boys. The goal of this study is to investigate the structure of students' interest in physics as well as the change in this structure from Grade 5 to 10 and certain conditions which might hinder or promote a positive development. The study combines a cross-sectional and a longitudinal study. The theoretical background of the study is provided by a curricular Delphi study answering the question of what physics, in terms of physics related topics, contexts and activities, ought to be taught in school. The results show that there is no overall decrease in students' interest in physics and that in comparison with the topics the contexts and activities chosen to teach a particular topic play by far the greatest role in determining especially female students' interest in physics. There is also a substantial congruency between students' interest in physics and the kind of physics education identified as being relevant in the Delphi study.

Hofstein, Avi

Strand 2 — Mon, 24 Apr, 1995 4:00 PM Washington

Students' Motivational Traits and their Preferences for Instructional Techniques in Science Classrooms: The Israeli Case

Sarah Shani

The study attempts to explore the relationship between students' motivational traits and their preference for different modes of instruction. Two instruments were used in this study: an instrument aimed at measuring students' motivational traits and an instrument aimed at assessing students' preferences for different instructional techniques usually used in the science classroom. The population (N=825) consisted of science students from junior and senior high schools in Israel. Multiple regression analysis revealed some interesting relationships between students' reasons for learning science (i.e. motivational traits) and their preference for different instructional techniques. It is suggested that these findings should have some applications for both curriculum developers as well as science teachers.

Holliday, William G.

Strand 10 — Tue, 25 Apr, 1995 2:30 PM Redwood

Listening to Other Voices by Broadening the Theoretical Dialogue: Theories of Integrating and Self-regulating Reading and Writing, Speech and Communication and Play

J. Randy McGinnis **Maureen M. McMahon** **Nancy W. Wiltz** **Stephanie A. Stockman**
Christine M. Kelly **Laura M. Barden**

This symposium uses an innovative triple-session format to advocate the integrative merging of uncommon theoretical perspectives in science education. This format will add cogency to our arguments in science education research by incorporating diverse thematic systems in planning and implementing research studies. Participants in the session, in small groups, will rotate through three strands heuristically identified as Other Voices One, Two and Three. Each strand will be independently conducted by panel members and later integrated by the entire panel. The three strands will present perspectives guiding research practitioners in separate fields in science education literature: integrating and self-regulating reading and writing theory, speech and communications theory and play theory.

Holthuis, Nicole E.

Strand 8 — Tue, 25 Apr, 1995 8:30 AM California

Science Education's Selective Reading of the History and Philosophy of Science: The Case of Project 2061

Julie Bianchini **Vicky Webber**

To what extent does the nature of science described in current science education reform initiatives reflect recent work in the history, philosophy and sociology of science (science studies)? In this paper we consider one case of how the nature of science is described by a major science education reform effort, Project 2061. We examine documents published by Project 2061, in order to summarize the nature of science as presented by the Project, to situate it within the greater discourse of science studies and to highlight possible tensions between the Project's description of science and its goal of science literacy for all. Using the categories of the nature of scientific explanations, the validation of scientific knowledge, the historical development of science and the ontological import of scientific knowledge, we explain that Project 2061 presents an incomplete and at times, outdated view of the nature of science. We offer several explanations for the Project's perspective on the nature of science and discuss the possible consequences of this presentation on science education.

Hsiung, Chao-Ti

Strand 4 — Mon, 24 Apr, 1995 10:30 AM Washington

Autonomy: A Constructivist Learning Environment

This study, in cooperation with an American teacher, utilized interpretive research methods to explore a constructivist learning environment. The study took place in the United States at a southeastern university laboratory school (K-12). The participants in the study included Mr Hook and his eighth grade physical science class (males = 13, females = 8). Fieldnotes, pictures, transcripts of interviews, students' written projects, journals, a biography of Mr Hook and his Master's thesis, framed a context of a favourable constructuive science learning environment. The learning activities associated with "electricity" and "alternative energy resources" capitalized on autonomous learning supported by multi-learning resources, challenging tasks, cooperative environments and alternative assessments. Autonomy is a main construct developing out of this study. Autonomy is a referent for active learning. It is the intended outcome of an emancipatory, constructivist curriculum.

Hsiung, Tung-Hsing

Strand 4 — Sun, 23 Apr, 1995 8:30 AM Emerald

Educating the Reflective Elementary Science Teachers in Taiwan

Chao-Ti Hsiung

The purpose of this study was to investigate the impact of applying a reflective teaching strategy to help prospective teachers learn how to teach elementary science. A college professor who taught research methods in the elementary science teaching program and two classes (72 junior prospective teachers) participated in this study. The professor designed an educating reflective science teacher curriculum for these two classes. The content consisted of using metaphor to reflect on their roles of being a science teacher, using 3-D pictures to reconstruct the meaning of learning, using personal drawings to mirror the images of the nature of science and learning from field experience. Data were collected by journals, reports, logs and interviewing transcripts. The researcher wove the pieces of their thought pieces into a web which represented an educating reflective teacher program. Results of the present study showed that students had a positive attitude to the reflective teaching method. It helps them to build their confidence in encountering different challenges from the real schools and also broadens their vision to see the importance of other subject matters. However, a few students pointed out that they were allowed to have more time to rethink the meaning of this reflective strategy than constructing their own instruction for their classrooms. On the basis of the findings, the study's educational implication and suggestions for further research areprovided.

Huang, Iris T.

Strand 1 — Sat, 22 Apr, 1995 7:00 PM Portola

The Effect of Concept Mapping on Achievement in Grade 7 Biology

Hsiang-ju Wang

The main purpose of this study is to investigate the effect of concept mapping in junior high school Biology classes. The study is a quasi-experimental design to examine three instructional strategies: concept mapping instruction with a team of students as a unit to make a concept map, concept mapping instruction with an individual student as a unit to make a concept map, and the traditional approach. A total of six classes, 296 Grade 7 students and two Biology teachers, participated in this study. Three classes were randomly assigned to each teacher with these three instructional strategies. The Biology achievement test was designed as the instrument to be used in pre-test and post-test administrations to demonstrative difference in the three strategies, but that there is a difference between the different strategies and learning potential of the students. After further analysis a significant difference is shown in the low-learning potential group. Students exposed to the concept mapping instruction approach with a team as a unit making a concept map, had higher test scores than those using the traditional approach.

Hudson, Sharon P.

Strand 10 — Sun, 23 Apr, 1995 1:00 PM Monterey

Certification Standards and Science Teacher Supply

This study examined the hypothesis that certification standards rather than salary are used to influence science teacher supply. The independent variables in this study were science teacher certification standards, reciprocity pacts, Alternative Certification and teacher salary. There were several major conclusions in this study. Significant positive correlations were found between science teacher supply in one or more science subjects and the existence of a broad-field endorsement; number of hours science required for for a broad-field science endorsement; number of subjects covered by a broad-field endorsement; and number of states in a state's reciprocity pact. A significant negative correlation was found between science teacher supply in several science subjects and the existence of Alternative Certification. Teacher salary index (average teacher salary divided by average per capita income) was remarkably uniform and no significant differences were found among regions of the country. A significant negative correlation was found between salary index and teacher supply in several science subjects. This study provided evidence that states react to shortages or surpluses of science teachers by raising or lowering certification standards in lieu of salary.

Hudson, Terry

Strand 3 | Sun, 23 Apr, 1995 2:45 PM Suite 2601

Teaching Approaches in English Science Classes: Has the National Curriculum Really Changed Them?

Robin Smith

Teachers' feedback during in-service courses designed to encourage the use of a wider range of teaching methods indicated that the pressure created by the introduction of a statutory national curriculum was restricting the teaching strategies they felt able to employ in their science classes. A postal questionnaire survey of over 150 teachers in a variety of schools across England compared the approaches they used in 1993 and before the National Curriculum. The questionnaire explored teachers' attitudes towards the changes and their attributions of the causes. While teachers were aware of a variety of strategies, they were making limited use of them and relying heavily on direct instruction and demonstration. Teachers attributed this to the overload of subject content and restricted time occasioned by the introduction of the National Curriculum. Use of some strategies, such as visits and field work, had decreased dramatically. The exception to this pattern appeared to be the increased number of investigations by pupils which are prescribed and assessed in the National Curriculum. Further surveys and interviews are being carried out in 1995.

Huffman, Douglas

Strand 1 | Sun, 23 Apr, 1995 4:00 PM Suite 2625

The Effect of Explicit Problem Solving Instruction on Students' Problem Solving Performance and Conceptual Understanding of Physics

Pat Heller

The purpose of this study was to determine whether students who were taught how to use an explicit problem solving strategy exhibited more improvement in problem solving performance and more improvement in conceptual understanding of Newton's Laws than students who were taught how to use a textbook problem solving strategy. Two high school physics teachers taught half their classes how to use an explicit problem solving strategy and the other half how to use a textbook problem solving strategy. Once students became proficient in the use of their respective strategies, both groups were taught an identical unit on Newton's Laws. Students' problem solving performance and conceptual understanding of Newton's Laws were assessed before and after instruction. Results indicated that the explicit problem solving strategy improved selected aspects of students' problem solving performance more than the textbook strategy, but did not improve students' conceptual understanding of Newton's Laws more than the textbook strategy. However, there were indications of a significant interaction on measures of conceptual understanding between problem solving strategy and sex of the student. The implications of these results for physics instruction will be discussed.

Hug, William

Strand 4 | Sun, 23 Apr, 1995 10:30 AM Monterey

The Influence of an Outdoor School Experience on a Prospective Teacher Learning to Teach Science

Lois M. Campbell

The purpose of this qualitative research was to observe, describe and analyse how a prospective teacher experiences the process of learning to teach in an outdoor setting. The nature of the research question and the culture of the residential outdoor education program called for a study in which rich, detailed descriptions and analysis could be made to describe the experience of learning to teach. The research question that guided the development of the methodology was: How does a prospective teacher participating in a residential outdoor education program understand the process of learning to teach? The informant was a prospective teacher from a large Northeastern university participating in a residential outdoor education program conducted by a university based environmental education center. The researcher adopted the role of participant observer to collect data from field observations of the informant's teaching, interviews and the informant's journal. Analysis yielded multiple assertions about the learning to teach process. First, that through this informant's acts of teaching science in the Outdoor School Program, her understanding of science concepts has grown. Second, that one of the primary ways she learns to teach is through direct interaction with children.

Huinker, DeAnn

Strand 4 | Sat, 22 Apr, 1995 7:00 PM Redwood

Impact of Methods Courses on Preservice Elementary Teachers' Science and Mathematics Teaching Efficacy

Sandra Madison

This investigation examined the impact of methods preparation at an urban university on preservice elementary teachers' self-efficacy beliefs in the areas of mathematics and science. Two studies were conducted, one in the Fall semester with 34 subjects and the other during the Spring semester with 30 subjects. The preservice teachers were concurrently enrolled in science and mathematics methods courses which shared a joint urban fieldwork component. The Science Teaching Efficacy Belief Instrument (STEBI-B) and modified form for mathematics were administered at the beginning and again at the end of each semester. The data revealed significant increases on personal teaching efficacy and outcome expectancy for both science and mathematics in both studies.

Hurd, Paul DeHart

Strand 5 — Mon, 24 Apr, 1995 4:00 PM Emerald

Comprehending the Current Guidelines for Science Education Reform

An interpretive analysis of the 1960s science education reform movement shows cause why, by 1970, there began a public outcry for a drastic new vision of a citizen's education in the sciences. Beginning in the 1940s revolutionary changes have developed in the nature and practice of contemporary sciences. At the same time, massive and accelerating transitions have taken place in our society, life styles and family structures, and in how people live, learn and work. Science and technology have been at the roots of these alterations in human society. A major result has been the creation of a knowledge-intensive society. Together these forces call for a type of science education very different from that of the past. The trend over the past 25 years has been to try to improve existing curricula rather than invent new science curricula suitable for the world in which our young people will live.

Hurst, Roy

Strand 1 — Sun, 23 Apr, 1995 4:00 PM Suite 2625

Fostering Effective Prediction Problem Solving Through Cognitive Analysis and Guided Practice

The purpose of the study was to identify cognitive factors related to differences in prediction problem solving success among high school Biology students and to investigate the effects of guided practice on predictive success. The Group Test of Logical Thinking (GALT) was used to assess subjects' cognitive level, while written prediction tests and think-aloud interviews were used to identify problem-solving tendencies and to measure predictive success. Treatment consisted of eight hours of guided practice using interactive computer simulations, after which all subjects were retested. Predictive reasoning success showed a significant correlation ($p < .01$) to formal operational development and to five specific skills: (1) applying cause-effect reasoning, (2) evaluating several alternative solutions, (3) use of systematic problem solving strategies, (4) retrieval of relevant knowledge from long-term memory and, (5) reviewing solutions for logical inconsistencies. Analysis of covariance (ANCOVA) indicated significantly increased prediction success for treatment-group subjects following practice in the five identified skills ($p < .01$).

Husén, Torsten

Strand 10 — Sat, 22 Apr, 1995 7:00 PM Gold Rush A

International Encyclopedia in Historical Perspective

The second edition of the *International Encyclopedia of Education* (edited by Torsten Husén and T. Neville Postlethwaite in 1994) involved authors from 96 countries in writing over 1,300 articles encompassing 6,820 double-columned pages in 12 volumes and covering 22 major fields. The *Encyclopedia* is the largest scholarly work on education in the English language ever undertaken. The first edition of the *Encyclopedia* was selected by *Choice* magazine as the Outstanding Academic Book in 1987. The *Encyclopedia* represents the first major attempt to present an up-to-date overview of international scholarship on educational problems, theories, practices and institutions.

Hwang, Bao-tyan

Strand 1 — Tue, 25 Apr, 1995 8:30 AM Oregon

Students' Conceptual Representations of Gas Volume in Relation to the Particulate Model of Matter

Most high school chemistry curricula contain a unit on gas volume and a unit on the particulate nature of matter. Students have learned the concepts that matter is composed of particles and that the state of matter is explained according to the arrangement of these particles. The literature shows that the existence and persistence of adolescents' preconceptions about the particulate nature of gases is an important factor when considering the teaching of the principles or theories related to gases. The purpose of this study was to find out how the concept of gas volume was developed in Taiwanese students: (1) do the students, at different grades, following the instruction of the topic of particulate model of gas, understand the substantial nature of the volume of gases? (2) can they use the scientific model about particles to describe the situations of the volume of any pure gas or the mixture of two different kinds of gases which are contained in the same vessel? and, (3) what are the patterns of the students' responses on the volume of a single gas or the mixture of two different gases through particulate theory of matter? Totally, there were 1029 students as the subjects. The main findings indicated that though the students had studied the conception related to gas volume, they still hold some of the misconceptions when they encountered such problems. The thinking modes of students' answers and reasoning about these kinds of questions were also analyzed in this study.

Jackson, David F.

Strand 7 — Mon, 24 Apr, 1995 4:00 PM Portola

Case Studies of Microcomputer and Interactive Video Simulations in Middle School Earth Science Teaching

This paper presents three case studies of middle school classrooms in which computer and video materials were used to teach topics in earth and space science through interactive simulations. Cases were chosen to span a range of grade levels (from sixth through eighth), teachers' levels of experience (from student teacher through 14 year veteran), levels of technology used (from Apple II computers with monochrome screens through Macintosh-controlled interactive videodisks) and classroom organisation patterns in relation to technological resources (from teacher-centered presentations with individual seatwork through small group exploratory activities in a multiple-computer setting). Results illustrate specific instances supporting previously reported general assertions that: (1) students' actual behaviour and descriptions of learning experiences are often very different from those ideally envisioned by their teachers, (2) classroom procedures and task structures established by teachers are often inconsistent with the original intentions of software and video designers and producers. Suggestions are made regarding improved design principles for such materials and how middle school science teachers might better conduct lessons using such simulations.

Jackson, Shari

Strand 7 — Sun, 23 Apr, 1995 10:30 AM Gold Rush B

Learner Centered Software Design to Support Students Building Models

Steve Stratford Joeseph Krajcik Elliot Soloway

Leaner-centered software design suggests that software tasks, tools and interfaces can and should be designed to support the unique aspects of learners: growth, diversity and motivation. We present a framework for learner-centered design and describe its application to the design of the ScienceWare Modeler, a tool to support learning and doing scientific modeling and simulation. We then present a case study of how the Modeler was used in a high school class: students who knew nothing about modeling quickly built and tested simple models of stream ecosystems. We also analyzed how various components of the Modeler intentionally supported the task of modeling by meeting specific learner needs.

James, Robert K.

Strand 4 — Sun, 23 Apr, 1995 1:00 PM Gold Rush B

Preliminary Results and Design Issues for the Salish Project

Robert Yager Herbert Brunkhorst Patricia Simmons Mark Twiest
James Gallagher Tina Marshall-Bradley Sheryl McGlamery Gerald Krockover Barbara Spector

Ten universities are collaborating in the Salish project, a three year study of their new science teacher graduates. The Salish project will link science teacher program characteristics to teacher classroom behaviors and student outcomes. Over the three year period of the project, 300 new science teachers and 7500 students will be involved in the study. A variety of instruments have been selected to assess each of the variables. Several design issues have been encountered. This report on initial results reviews outcomes the teacher preparation program study, the teacher classroom behavior study and the student outcomes study. Researchers will present preliminary results and hypothesize interrelationships within the data. Participants will interact with project associates regarding instrumentation, design issues and data interpretation issues.

Jarvis, Tina

Strand 1 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Using Drawings to Investigate Children's Understanding of Concepts

Leonie Rennie

This study examines the use of drawings as a means of investigating children's understanding of the concept "technology". The specific research questions are: Do children's drawings reflect the range of ideas children have about technology? Are the drawings interpretable to others? Do the drawings accurately represent children's understanding about technology? Data were collected from 81 elementary children in England and 160 children in Western Australia. Children were invited to demonstrate their knowledge and understanding about technology by responding to a writing/drawing activity and were then interviewed about their responses. About two thirds of children's responses to the activity included drawings. Overall, children held a wide range of ideas about technology and these were adequately reflected in their drawings. Only rarely was the drawing difficult to comprehend. Consistent with the ideas represented in the drawings, the interviews found that younger children held simpler ideas about technology, while older children held more complex and sometimes quite abstract concepts of technology. A notable difference was the emphasis on "design and make" in the English responses and a larger proportion of no response, both reflecting the more advanced state of technology education in England compared to Australia.

Jasalavich, Sheila M.

Strand 3 — Sun, 23 Apr, 1995 2:45 PM Suite 2601

Preservice Elementary Teachers' Rationales for Instructional Preferences Regarding the Teaching of Science in Elementary School

The purpose of this study was to elicit and analyze preservice elementary teachers; rationales for instructional preferences regarding the teaching of science in elementary school. Two hunred and seventy preservice elementary teachers completed the BATALS survey. Their responses to selected items and rationales for their responses were transcribed into a data base. Inductive analysis and matrix compilation of responses and rationales indicate that many preservice elementary teachers utilise predominantly affective criteria inconsistently when making instructional choices. Others however, consider both affective and cognitive criteria and apply their criteria fairly consistently. Olson's notion of commonsense knowledge adequately described only some preservice teachers' thinking. Others exhibit a deeper level of metacognition and reflection.

Jeffries, Carolyn L.

Strand 3 — Sun, 23 Apr, 1995 8:30 AM Emerald

Elementary Teachers' Science Conceptions, Attitude Toward Teaching Science and Science Teaching Style

This study looked at elementary teachers' life science conceptions, attitude toward teaching science and science teaching style. A questionnaire was administered to 32 elementary teachers in four schools in the greater Los Angeles area. The questionnaire consisted of a life science alternative conception test, a science attitude scale, a science teaching style scale and teacher background questions. The results showed that the majority of the elementary teachers surveyed had alternative conceptions in the areas of breathing, respiration, definition of animals, natural selection and evolution, had a positive attitude toward teaching science and reported using a teacher-centered science instructional style. This study has implications for the implementation of new science curricula that require a good content understanding and a student-centered nontraditional teaching style.

Jegede, Olugbemiro

Strand 2 — Mon, 24 Apr, 1995 10:30 AM Nevada

Students Perceived and Preferred Socio-cultural Classroom Climate in a Non-Western Environment

Rose Agholor Peter Okebukola

The study compared the actual and preferred forms of the Socio-cultural Environment Scale (SECS) with a view to determine if there are differences in the perceived and actual science classroom environments as viewed by students in a non-Western culture. It also investigated the validity and reliability of the new (perceived) form of the instrument. All 328 students attending a summer vacation school in Festac housing area, mostly populated by middle income earners, in Lagos participated in the study. The two forms (perceived and preferred) of the SCES each containing 30 items grouped in five subscales were used for data gathering. The instruments, developed for use in non-western science classrooms, were found to be highly reliable using the Cronbach Alpha procedure (r for perceived = 0.92, r for preferred = 0.73). The results indicated that students opinions differed between actual and preferred classroom climate. Paired t-test comparing opinions of students in the five subscales of the two forms of SCES indicated significant differences a $p<.01$. The second form (preferred) of the instrument exhibited a high concurrent validity ($r = 0.72$) with the perceived form. The implications of the results are discussed.

Jensen, Murray

Strand 4 — Mon, 24 Apr, 1995 8:30 AM Suite 2601

A Description and Evaluation of Two Instructional Strategies used with a Diffusion and Osmosis Computer Simulation

The increased use of computer-technology in science education is well documented. However, little research has been done on how to best use this technology in the lecture classroom. This study provides data as to the effectiveness of two different instructional techniques used in concert with the same computer simulation on diffusion and osmosis. One instructional strategy used a student writing component and the second used a procedure known as paired problem solving. Results from this study showed students who used the paired problem solving produced larger gains than students using the writing strategies.

Johnson, Judith

Strand 10 — Sun, 23 Apr, 1995 1:00 PM Monterey

Teachers and Research: Partnership for Reform

The Martin Marietta/University of Central Florida Academy for Mathematics and Science is an education/industry/community partnership aimed at improving mathematics, science, and technology education in Florida. The purpose of this study is to examine the role of teacher research in the reform of K-8 mathematics and science education. Some of the questions guiding my study included: How does the Martin Marietta/UCF Academy focus on teacher research serve to address the goals of science and mathematics reform? What are evidences that the Martin Marietta/UCF Academy supports sustainable change in schools? The interpretive research design, a form of qualitative research, was used to explore the meanings that the teachers constructed and created from their experiences during the Martin Marietta/UCF Academy program and to describe the impact of the project in terms of educational reform (Bogdan & Biklin, 1982). While the dominant theme emerging from the data is change, the patterns describing change can be categorized into personal change and teacher empowerment, as well as changes that promote school or institutional reform.

Johnson, Sandra

Strand 6 — Tue, 25 Apr, 1995 2:30 PM Emerald

The Biological and Physical Science Interests of Gifted Kindergarten Girls

The purpose of this investigation was to observe and describe the biological and physical science interests of gifted kindergarten girls. The subjects were fourteen kindergarten girls identified by their school districts as gifted. Each girl was videotaped taking part in five sessions of science activities. Each session presented one biological activity and one physical science activity. Each activity was open-ended allowing the girls to interact with the materials in unstructured ways. Interviews with the parents of each girl were conducted to ascertain any science interest exhibited outside of school. Videotapes were analyzed for: (1) time spent on task, (2) science process skills used and, (3) cognitive levels exhibited. Information from parent interviews was tallied. Findings indicate that these gifted kindergarten girls exhibit near equal interest in biological and physical science as measured by time spent on task, number of science process skills used and number of cognitive levels used in each type of science activity. Out-of-school science experiences based on activities provided by parents were four times as likely to be in the area of biological science as in physical science.

Johnston, David

Strand 10 | Sun, 23 Apr, 1995 7:00 PM Exploratorium

Perceptions of Visitors' Learning at an Interactive Science and Technology Centre

Léonie Rennie

This paper reports part of a larger study into the learning of the general public during visits to an interactive science centre. Much previous research on visitors' learning has focused on students, whereas the explainers, who have most interaction with visitors, have rarely been used as a data source. Reported here are the views of a representative sample of explainers from a science centre and the reactions of a sample of visitors to those views. Data were collected through interviews and conclusions scrutinised by a wider group of explainers and visitors. The findings suggest that explainers believe that: (1) visitors have fun at the centre, (2) learning is not the main purpose of the visit, (3) their own role is to facilitate understanding of the exhibits, not to teach, (4) learning occurs when visitors relate experiences at the centre to experiences in the outside world, (5) analogies facilitate understanding and, (6) incidental learning, unrelated to the intention of an exhibit, often occurs.

Johnston, Jane

Strand 10 | Sat, 22 Apr, 1995 7:00 PM Suite 2625

The Gap between the Public Perception of Science and the Realities of Science

This study developed from a project to develop a positive image of science in primary school parents and governors through the development of an interactive workshop. The project revealed that whilst parents recognized the importance of Science, they considered it to fall within a restricted positivist paradigm and its general educational contribution were not readily understood. It also revealed a gap between the parents' perceptions of science and the part played by science in their everyday lives. This study uses three strategies, questionnaire, picture discussion and interview to investigate the apparent gap between perceptions and realities of science. The formats for these were designed by the author. The resulting data is expected to assist tin the development of further workshop activities for use with parents of primary school children. These activities will attempt to challenge the view that science plays little part in everyday lives.

Jones, Gail

Strand 4 | Sun, 23 Apr, 1995 2:45 PM Washington

Through a Sideways Door: A Resource Model of Science Teacher Change

Elizabeth M. Vesilind

What happened in teachers' professional growth during a university/school collaboration intended to effect better science teaching? The purposes of this case study were to describe what it was like to have been lead since teachers in two elementary schools, to explore the influence of school context on lead teachers' beliefs and leadership roles and to sort out what aided and what hindered the desired teacher change. Notes, documents and interviews were collected from lead teachers, other teachers, principals, project instructors and parents. Results showed that lead teachers worked in contexts where perceived equality of teachers and privacy of teachers' classrooms made science teacher leadership difficult. Lead teachers viewed their roles as resources, representatives and as "funnels". There was a tacit agreement among the participants that lead teachers would not directly confront, but would lead to change science teaching "through a sideways door". The study also found that teachers, university faculty, principals and lead teachers have different visions about good science teaching. These diverse visions from stakeholders competed at times, reducing the effectiveness of the intended reform.

Jones, Leslie S.

Strand 10 | Tue, 25 Apr, 1995 8:30 AM Monterey

Implementing Conceptual Change Instruction: One Teacher's Experience

Michael Beeth

This paper documents the Conceptions of Teaching Science (CTS) held by an elementary teacher. As part of a longitudinal study on conceptual change teaching and learning, it was necessary to document this teacher's initial conception of teaching science in order to determine if changes in the teacher's thinking affected instruction and student learning and if so, how. The CTS interview contains ten scenarios of common teaching experiences and asked the respondent to determine if teaching and/or learning are happening in each instance, and if so, how they know. Statements from the interviewee are assigned to categories related to teaching or learning (e.g. nature of science, learning, learner characteristics, rationale for instruction and preferred instructional techniques). Analysis of the categories and relationships between categories resulted in this teacher's Conceptions of Teaching Science. The protocol for this interview will be repeated through the longitudinal study. However, scenarios from actual classroom events will be used to challenge the teacher's CTS and to determine the impact changes in this teacher's CTS have or are having on students' learning.

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Jones, Loretta

Strand 4 — Sun, 23 Apr, 1995, 4:00 PM, Washington

Science Reforms in the Rocky Mountain Teacher Education Collaborative

Jay Hackett

This paper describes the five year goals and the first year accomplishments in the reform of science majors courses targeted in the accomplishments in the reform of Science majors courses targeted in the Rocky Mountain Teacher Education Collaborative. Interdict courses in Chemistry, Biology, Physics and Earth Science are being redesigned to model effective, content-specific, inquiry-based, problem solving, constructivist instructional strategies. During the first year, these goals focus on introductory Chemistry courses and the first revisions are currently being implemented. In the summer of 1994, content teams consisting of project faculty from each of the three participating institutions met to develop a common framework for reform. Chemistry revision teams within each institution then met over the summer to revise introductory Chemistry courses. Examples of course activities and other results are described.

Jones, Loretta

Strand 1 — Sun, 23 Apr, 1995, 8:30 AM, Gold Rush A

Visual Learning

Marcia Linn **Bob Sherwood** **Dorothy Gabel** **Carl Berger**
Janet Bohren

This session will present an introduction to a set of issues around the importance of visual learning of science. Each speaker will present some brief comments on visual learning: Jones—visual skills, a key to concept learning; Bohren—visual learning and reading the image; Sherwood—visual learning and problem solving; Gabel—visual learning and expert teachers; Berger—visual learning and student sequencing; Linn—visual learning and simulations. An interactive audience discussion will follow. Our profession is very oriented toward the verbal and mathematical presentation of science, despite the increasing opportunities technology provides us to use and manipulate images for instruction. Technology advances have also brought increased attention to the important relationships between visual and kinesthetic learning. This symposium will provide a forum for us to discuss these issues and plan for further exploration at future NARST meetings.

Jungwirth, Ehud

Strand 5 — Sun, 23 Apr, 1995, 8:30 AM, Monterey

The Effect of Within-test and Between-tests Teaching Interventions to Help Subjects to Attend to the Logical Structure of Scientific Situations

The educational objective of inculcating critical thinking habits has been universally recognized for more then 100 years. The present author has amassed an international data-base showing that "analytical enquiry skills" are applied spontaneously by only a minority, another minority apply them only after prompting, while a very large proportion perform negatively when required to analyse critically conclusions drawn from logically faulty situations. A special version of the *Analysts Of Scientific Passages Test* was constructed, containing brief teaching-situations relating to four logical fallacies. These raised (in the USA and Israel) sample-means considerably, but not above the 55% level at the secondary and tertiary levels. A pretest, intervention, post-test strategy was tried at the tertiary level (in South-Africa and the USA). This one-hour lecture/discussion intervention raised sample means across fallacies from about 20%-30% to about 70%-90%. It was recommended that both kinds of interventions be part of the teaching-repertoire of science teachers, after ascertaining the level of availability of such skills among their students.

Kali, Yael

Strand 1 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

Spatial Abilities of High School Students in the Perception of Geological Structures

Nir Orion

The specific spatial abilities required for the study of basic structural geology were characterized by quantitative and qualitative data analysis. A geological spatial ability test (GeoSAT) was developed and administered to 115 comprehensive high school students, from which six were interviewed. An analysis of students' incorrect answers, revealed two types of answers: (1) "non-penetrative" answers, which were based on external exposures of the structure and, (2) "penetrative" answers, which indicated attempts at representing internal properties of the structure. Students who tended to give "penetrative" incorrect answers performed significantly higher than students who tended to give "non-penetrative" incorrect answers. The reasoning of students for the different types of answers, as determined by interviews, supported the initial assumption that answers were given by students with different levels of an ability to visually penetrate into the image of a structure, which was named "visual penetration ability" (VPA). The interview findings indicated that the VPA is one of two complementary factors needed for solving the problems of GeoSAT, the other factor being the ability to perceive the spatial configuration of the structure. It is concluded that teaching and curriculum material should provide students with assistance in both these areas.

Kamen, Michael

Strand 2 — Tue, 25 Apr, 1995 1:00 PM Gold Rush A

An Analysis of the Role of Language in Inquiry Science Learning: Part 1

Wolff-Michael Roth **Laura Barden** **Bonnie Shapiro** **Jay Lemke**
Elizabeth Kean **Penny Gilmer** **Stephen Marble**

Members of the Special Interest Group on the Role of Language in Science Learning will present an interactive session to explore the role of language in inquiry science learning. A videotaped segment of a classroom science lesson in which three students plan the construction of an earthquake proof tower will be shown. Each panelist will present an analysis of the use of language in the lesson indicating specific issues and how they relate to a theoretical perspective, research and the classroom teacher. The session will include large and small group discussions about the role of language in the teaching episode viewed. The videotape may be viewed during a presession meeting. Transcriptions of the videotape will be available prior to the session.

Kamen, Michael

Strand 2 — Tue, 25 Apr, 1995 2:30 PM Gold Rush A

An Analysis of the Role of Language in Inquiry Science Learning: Part 2

Wolff-Michael Roth **Laura Barden** **Bonnie Shapiro** **Jay Lemke**
Elizabeth Kean **Penny Gilmer** **Laura Barden**

Continuation of the above session

Karunaratne, Sunethra

Strand 6 — Tue, 25 Apr, 1995 1:00 PM Emerald

Can At-risk Students Envisage Their Potential to be Scientists?

This study describes a project designed to build interest in science in low self-esteem children through the involvement of parents in an after school setting. This project was a version of the national Family Science program modified especially for Hispanic students. This paper describes how ten Grade 7 and 8 students in a middle school, who were labeled as at-risk students by the school staff, were able to envisage their potential to be scientists by assisting Grade 3 and 4 students in doing hands-on science activities. They were called "junior scientists", and received a training prior to the regular sessions. Three parents of elementary children also worked with them in small groups. The sessions were held once a week for about one and a half hours for ten weeks in two semesters. Detailed analysis of audio taped interviews, ethnographic observations and children's documented work, found that middle school students as well as elementary children developed stronger aspirations to be scientists. The responsibilities given to junior scientists enabled them to build up high self-esteem. They also developed positive attitudes toward science and scientists, and skills in doing science activities through engagement in a scientific process.

Kass, Heidi

Strand 2 — Mon, 24 Apr, 1995 2:30 PM Redwood

The Construction of Knowledge-in-action by Students and Teacher in an Enactive Science Classroom

A. Leo MacDonald

This study examines the development of nonpropositional and enactive forms of knowing that arise when students and teacher engage in open-ended activities involving self-directed design and building of various structures using simple materials. It is grounded in the view that active creation of thought-action processes for interacting with the world is interwoven with the meanings that are constructed for these experiences. The action setting focused on manipulation of objects, perceptual interactions and various sensory experiences. How do students and teacher co-create acts of learning in an enactive science classroom? A second-order phenomenographic perspective is used to interpret and connect action and discourse to reveal aspects of the mutual specification of meaning for participants. Both teacher and student perspectives on what they are doing changed as their understanding evolved. Many students considered themselves to "be in their investigation" and became more proactive in the classroom decision making process, particularly the assessment of their work. Conversely, the teacher perceived increased pedagogical value in non-directive interactions, leading to a reconceptualization of her teaching style.

Kattmann, Ulrich

Strand 1 — Mon, 24 Apr, 1995 2:30 PM Oregon

A Model of Educational Reconstruction

Reinders Duit

Clarification of science subject matter is a key issue if instruction of a particular science content (such as evolution, photosynthesis, or energy) is to be developed. Usually this clarification process is primarily or solely informed by issues coming from the structure of the referring science content. Educational issues then are regarded only after the science subject matter structure has been clarified. Our model of educational reconstruction closely links hermeneutical—analytical research on the science content structure and the educational significance of parts of it and also includes empirical studies on students' understanding as well as preliminary trials of pilot instructional modules in classroom practice. It is, for instance, a key assumption of the model that the curriculum developer's awareness of the students' point of view may substantially influence the reconstruction of the particular science content. Experiences have clearly shown that intimate knowledge of students' conceptions may provide a more adequate understanding of the referring science content by the curriculum developer. The theoretical assumptions of the model as well as examples for its significance from projects in the domains of Biology education (visual perception) and Physics education (chaos theory) are discussed.

Keeves, John P.

Strand 10 — Sun, 23 Apr, 1995, 10:30 AM, Emerald

International Comparisons of Participation, Achievement and Attitudes

Key findings of the extensive second IEA Science Study of science participation, achievement and attitudes are highlighted. Some of the main topics covered are: participation and achievement rates in science in different countries; associations between science achievement, time spent on learning science, and opportunity to learn the content in the science test; and factors (e.g. home background, sex, aptitude) which affect science participation and achievement. These comparative data are used to identify and explain the influence of a wide range of factors on the outcomes of science teaching and learning for a large number of countries in different parts of the world.

Keeves, John P.

Strand 10 — Sat, 22 Apr, 1995, 7:00 PM, Gold Rush A

Advances in Research Methodology

The section of the *International Encyclopedia of Education* on Educational Research, Methodology and Measurement, edited by John Keeves, is concerned with the nature of educational research, the methods used in scholarly research in education, both of an empirical and a humanistic kind, and the issues encountered and the procedures employed in educational and psychological measurement, both for the purposes of research and as assessments of outcomes of educational practice. Recent developments have come from the power and ease of operation of microcomputers that have become widely available on the desks of education researchers. The field is one of exciting changes, sometimes heated controversy, and new understandings of educational processes. At the heart of these developments is the greater recognition that education is concerned with change in human characteristics, which needs to be accurately measured and which is influenced by factors operating at both the individual and group levels.

Keeves, John P.

Strand 5 — Tue, 25 Apr, 1995, 1:00 PM, Gold Rush B

What Have We Learned from 35 Years of IEA Studies?

This presentation identified key findings from the 15 major IEA (International Assocation for the Evaluation of Educastional Achievement) studies conducted over the past 35 years, and it draws out implications for all Educational policy and practice. Key findings include that: (1) average attainment is inversely related to the proportion of the age group enrolled, (2) the best students do not suffer with increased retention rates, (3) student achievement is prositively related to time given to the study of the subject at school, time spent on homework and the opportunity to learn the content, (4) using a textbook has an effect on student learning in developing, but not developed countries, (5) socioeconomic status of the home effects student achievement in all countries, at all age levels and for all subjects, and (6) achievement differences between the sexes vary in size and direction across countries, across school subjects and over time.

Keiffer-Barone, Susan

Strand 1 — Sat, 22 Apr, 1995, 7:00 PM, Portola

The Effects of Journal Writing in Secondary Physics

John Rowe — Barbara Groene

This study investigated the effects of journal writing on student achievement in physics in the areas of content knowledge and argument construction. The quasi-experimental design examined the progress of 133 students over a 22 week period in two mideastern, predominantly African-American urban high schools, where 51% of the population meet the Chapter 1 definition of poverty. Sixty-eight students produced teacher-directed "academic" journals responding to Physics prompts and 65 control students kept personal "dialogic" logs. MANOVA analysis of practitioner-designed post-test and semester grades resulted in no difference between groups in content knowledge ($p < .947$; $p < .740$ respectively). However, analysis of the post-test found this measure to be unreliable ($r = .255$). Thus, no clear conclusions were drawn regarding student content knowledge. Repeated measures MANOVA analysis of journal primary trait scores revealed a group-by-time effect in argument construction. Students writing academic journals exhibited greater improvement in overall paragraph rating ($p < .05$). Use and explanation of scientific evidence approached significance ($p < .06$). These results indicate that while teacher-directed journals appear to have a positive effect on student ability to write a well-constructed paragraph, this treatment did not yield greater utilization of content in student arguments.

Keiny, Shoshana

Strand 1 — Mon, 24 Apr, 1995, 10:30 AM, Oregon

STES Curriculum Development as a Process of Conceptual Change

We understand Beer Sheva as an alternative learning orientation, based upon the reflective, cybernetic paradigm, rather than another body of knowledge based upon the positivistic paradigm. Accordingly, science is conceived as man's construction of the worlds, instead of his endeavor to decode its underlying order. The main goal of Beer Sheva is to prepare students to cope with their future reality by identifying their unpredictable problems and taking responsibility to resolve them. This requires active responsible and independent teachers, who are prepared to question the authority of "objective knowledge", to construct their own knowledge and to take responsibility for their own system of knowing and acting epistemologically. This paper relates the story of a unique team (consisting of four teachers, three scientists, two historians, a curriculum developer and myself as co-ordinator) who met weekly in order to develop a Beer Sheva curriculum unit on the desert, a concept developed to include ecological, architectural, historical-cultural and humanistic aspects as well as future development implication. Teachers' conceptual change was assessed both in epistemological and pedagogical terms: namely in their idea of knowledge and teaching/learning behavior. It is assumed that the teachers' process of conceptual change is a process of growth and professional development that will result in the development of active and autonomous learners.

Keller, Jill L.

Strand 5 — Sun, 23 Apr, 1995 10:30 AM California

Structuring Chemistry Laboratory Environments to Promote Critical Thinking and Learning

Philip C. Keller

An experimental course was designed to enhance the intellectual quality of a freshman chemistry lab program. Small student (S) teams received 1-4 weeks projects requiring group planning of experimental procedures, analysis of intermediate results and revision of experimental method. Groups received feedback from "consultants" (TAs and faculty). Groups wrote preliminary proposals before starting work and progress reports after each lab. Ss wrote individual final reports incorporating individual and group data and results. Ss used word processors for reports and spreadsheets for data presentation (graphing) and analysis. Results indicated Ss looked forward to coming to these labs more than regular labs. Ss found the work more interesting; they worked harder; they better understood what they were doing; and they thought more carefully about the meaning of their work. Ss showed significant improvement in their ability to represent data and to draw and support their conclusions. At first, teachers (Ts) felt a loss of control over S activities and the information to which they were exposed. After the first two projects, Ts said they were comfortable with the format and thought Ss were learning more, asking more thoughtful questions and had a better attitude in lab.

Kelly, Gregory

Strand 1 — Mon, 24 Apr, 1995 8:30 AM Nevada

Students' Reflections on MBL Instruction: Interests, Frustrations and the Role of Gender

This project seeks to incorporate students' voices into the evaluation of technological innovation. I interviewed 20 students who had recently completed a microcomputer-based laboratory (MBL) physics course. I used constant-comparative analysis to code and categorize the interview data. Three themes are evidenced in this analysis: (1) students had generally, but not entirely, positive views concerning MBLs, they appreciated the hands-on aspects of the lab and computer generated representations of data, (2) some students, particularly women, felt they didn't get equal access to the computer during the laboratory experiments, this issue was found to be related to gender, confidence, perceived competence and the social context of the collaborative groups, (3) in contrast to the cognitive perspective offered in the literature concerning the use of computers in science laboratories, students brought to the experience their own agenda. Students' diverse interests and reasons for their feelings concerning MBLs are discussed and, (4) I suggest what this project implies for further research concerning the use of computers in schools.

Kermis, William J.

Strand 10 — Tue, 25 Apr, 1995 2:30 PM Emerald

Testing Stimuli and Associated Neurophysiological Responses: Methodological Problems Related to Digital Analysis of Analogue Data

The purpose of this study was to develop a methodology for the direct measurement of anxiety in response to testing stimuli. Three europhysiological parameters of measurement were selected. Those parameters selected were cardiac, galvanic skin and respiration responses. Ten debilitating testing stimuli and ten facilitating testing stimuli were used. Those testing stimuli were validated in a previous experiment. Seventy-four subjects were randomly selected to participate in the experiment. A three channel physiography was used to collect data simultaneously on the three Neurophysiological parameters. The analogue data were converted to digital data for the purpose of analysis. Although there were several methodological problems encountered with the analogue to digital conversion, results confirmed the association between testing stimuli both debilitating and facilitating and Neurophysiological response. The implication of direct measurement versus indirect measurement (i.e. psychometric measures) and validation of existing test anxiety scales are described further in the paper.

Kesner, Miri

Strand 5 — Mon, 24 Apr, 1995 8:30 AM Gold Rush B

How to Make Chemistry More Relevant to the Student

Avi Hofstein Ruth Ben-Zvi

The implementation of industrial chemistry case studies is often inhibited by the chemistry teacher who had, in most of the cases, very little experience with such topics in basic preservice training. This study describes a "creative" inservice training program conducted in Israel aimed at acquainting chemistry teachers with a variety of instructional techniques that could be utilized while teaching industrial chemistry topics. Assessment of students' teaching industrial chemistry topics. Assessment of students' perceptions of the learning environment and interests, using a 40 items (8 scales) Likert type inventory, revealed the following: (1) students who learned industrial chemistry outperformed students who did not learn industrial chemistry on the following scales: "relevance", "applicability", "becoming future citizens", (2) students who studied industrial chemistry with teachers who had undergone intensive "creative" inservice course outperformed students whose teachers had undergone only a regular training on the following scales: "relevance", "applicability", varying classroom procedures and, (3) on the whole, no difference was revealed between boys and girls. It has been demonstrated that both girls and boys found industrial chemistry relevant and applicable.

126

Keys, Carolyn W.

Strand 2 | Mon, 24 Apr, 1995 8:30 AM Suite 2625

Initiating Authentic Investigation in an Urban Middle School: Indicators of Success in Scientific Reasoning and Writing

Tarriatine Simmons

This study describes preliminary findings for the implementation of an "authentic" model of instruction, the generative model (Harlen & Osborne, 1985), in an urban middle school setting. This model has potential for developing a particular dimension of science literacy: the ability to read, write and understand the science genre experiment. The goal of the study was to identify grounded indicators of success for future evaluations of the model. Student written investigation plans and reports were analyzed using interpretive methods. The results show that important indicators of success for student-designed investigations include: writing clear inquiry questions, identifying appropriate outcome measures and specifying fair test conditions. The best written conclusions directly answered the investigation question and cited evidence but rarely elaborated on an explanation or theory. The findings suggest that grounded indicators closely match theoretical indicators suggested by Harlen & Osborne, as well as, consensus views of quality writing in the genre, experiment. The model appears to be well suited for constructing thinking and writing skills, though integrating new information with prior knowledge remains a challenge.

Klapper, Michael H.

Strand 4 | Mon, 24 Apr, 1995 8:30 AM Redwood

A Survey of Scientific Understandings: Comparison between Teachers and College Students

Shirley DeLucia Jeffrey Trent

A 25 question survey was constructed to determine basic science understandings. This survey was administered to students enrolled in college non-major introductory science courses and to teachers in summer elementary and middle school science or mathematics workshops. The teachers did significantly better than the students, with the major differences in those questions dealing with earth/space sciences and mathematics skills related to science. While scores were correlated with previous science courses taken, those correlations were parallel for both students and teachers, suggesting that some factor other than formal exposure accounts for the difference. The teachers' scores were only weakly dependent on number of years teaching and number of previous workshops attended. Other potential explanations for the better teacher performances are also inconsistent with the data. We propose the hypothesis that the better performance of the teachers derives primarily from their own informal efforts to acquire the knowledge needed for their own teaching.

Knight, Stephanie L.

Strand 3 | Tue, 25 Apr, 1995 8:30 AM Gold Rush A

TARPS IV: Implications of the TARPS Model for Teacher Educators in Modeling Balanced Learning Environments

Dawn Parker

Relationships between students' perceptions of their learning environment and student outcomes has been well established. Instructional decision making oriented toward creation of appropriate learning environments is an important focus for teacher educators, particularly when there are concerns about the balance of content and effective instructional strategies. Research questions in the TARPS project centered on teachers' perceptions and subsequent planning of well-balanced lessons that considered both content and instruction. Data included, transcripts of think-aloud interviews that focused on instructional and curricular decisions, made during the development of integrated mathematics and science lessons, prior to exposure to the model, at the end of an intensive training session in the use of the model and after one semester of use of the model in their classrooms. Data also included questionnaires and observational data to assess teachers' perceptions and classroom behaviours related to the creation different types of learning environments. Results revealed initial differences in their perceptions of effective learning environments in their content areas. After intervention, teachers differed in their abilities to use the TARPS model in adapting their instructional planning and implementation.

Koballa, Thomas

Strand 5 | Sun, 23 Apr, 1995 4:00 PM California

An Evaluation Model with Participant Constructed Components

David Butts Joseph Riley

We are continually faced with making judgments about what difference a program makes for the participants. Evaluation models can be used that range from predetermined goals to goal free designs. However, in PACE, the unique dimension is the use of participants in establishing both the goals and their usefulness. In the first step of the model, participants describe what they expect from the program, what they value from the program, what they intend to use from the program and later what they were able to use. The second step is the categorizing of participant responses and validation of these categories using a modified delphi technique. The last step is interpreting what made a difference based on the Koballa model of reasoned action—identifying those categories that represent internal desires contrasted with those external restraints. Thus, did it make a difference is answered in terms of what participants expected, what they valued, what they intended to do and in terms of what they actually did accomplish.

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Kokoski, Teresa M.

Strand 5 | Tue, 25 Apr, 1995 2:30 PM California

Restructuring the Content and Instruction of the Mathematics and Science Courses for Elementary Education Teachers

Anne Madsen Walter Thomas Kyner

This paper reports the combined efforts of faculty members of the College of Education, the College of Arts and Letters at the University of New Mexico, scientists from Sandia National Laboratories and classroom teachers to restructure the mathematics and science content courses taken by elementary education majors. The committee reviewed and them to national standards and directives. As a result, several standard reviewed, emerged to form the core of a model to improve the content instruction of science and mathematics courses. This paper presents a potential model for elementary teacher education based on collaborative efforts across the community and driven by national standards and directives.

Komorek, Michael

Strand 1 | Sun, 23 Apr, 1995 7:00 PM Exploratorium

A Learning Process Study on Elementary Features of Chaos Theory

Reinders Duit

This study is part of a larger project on educational reconstruction of elementary features of chaos theory, i.e., on analysing whether it is worthwhile and possible to introduce key issues of this theory into science instruction. The focus of the study is the issue of limited predictability of chaotic systems. Learning processes of 11 students (six females and five males; Grade 12, medium age 18; German Grammar School) are investigated by an approach that is based on Les Steffe's method of the teaching experiment. Interviews are deliberately used as teaching situations. There are four sessions of about 45 minutes with every student. Three sessions investigate the development of students' understanding the the referring learning processes, the last session takes place some 10 weeks later in order to investigate long term effects of the learning sessions. Results show that understanding of the issue of limited predictability is possible for all students involved on the basis of everyday ideas. Quite substantial conceptual change processes could be observed concerning students' general view of predictability in physics.

Koran, John J., Jr

Strand 10 | Sun, 23 Apr, 1995 10:30 AM Redwood

Research and Evaluation in Natural History Museums and Science Centers: Methodology, Findings, Applications

Mary Lou Koran Lynn D. Dierking Lehman Barnes

The terminology "research" and "evaluation" is frequently used interchangeably in museums and science centers. Since the intent of each is different, generalizability different, methodology frequently different, audience different and the use to which the findings will be put different, it is essential to differentiate between them. While elements of the methodology of each are similar, one demands rigor resulting in generalizability while the other less rigor leading to value judgments and decision making. The speakers in this interactive session will describe and illustrate this distinction in the research and evaluation studies reviewed. The application and significance of both types of procedures to the museum and science center setting will also be discussed.

Krajcik, Joseph S.

Strand 7 | Sun, 23 Apr, 1995 4:00 PM Gold Rush A

Technological Support for the Professional Development of Science Teachers

Elliot Soloway Ronald W. Marx Phyllis Blumenfeld Nathan Bos
Barbara Ladewski

Research on teacher change identifies the complexity in developing an understanding of the theoretical framework underlying new non-prescriptive approaches to teaching and integrating that understanding with rich visions of possible classroom enactments. Teachers need a great deal of support if they are to transit to new constructivist models of science teaching. This symposium explores the extent to which multimedia technology provides support to science teachers as they attempt to understand and enact new nonprescriptive approaches to instruction. Based on work with 60 teachers, the symposium considers how technology can be used as a partner for science teacher enhancement. We report the development and research on two technology tools in particular. Through the use of the first tool, the Casebook of Project Practices (CaPPs), we explore how teachers use multimedia tools to develop new ideas about science teaching. Examination of research on the second tool, the Project Integration Visualization Tool (PIVit), provides an opportunity to explore how graphic oriented tools help teachers plan and enact projects. Discussants representing multiple research and practice perspectives — including teacher learning, interactive multimedia design and public school practice — provide commentary on the design and use of interactive multimedia learning tools for teachers.

Kuiper, Wilmad

Strand 5

Tue, 25 Apr, 1995
8:30 AM
Redwood

The Implementation of Context and Activity Based Science Education: Intentions and Reality

Basic education is currently being implemented in Dutch lower secondary education (age 12 through 15). Basic education refers to a core curriculum of 15 subjects, among which are Physics-Chemistry and Biology. The most important aim of basic education is a curriculum reform. As to Physics/Chemistry and Biology a shift in emphasis from structuralistic and receptive to context- and activity-based learning is strongly advocated. This paper describes particularly the objectives, design and results of explorative case studies of the teaching practices of four exemplary Physics and four exemplary Biology teachers in lower secondary education in The Netherlands. The case studies were undertaken as a second step in a study focusing on getting a better understanding of the actual implementation of context- and activity- based science education. The first step encompassed a representative survey using a teacher questionnaire. The assumption underlying the case studies was that studying exemplary teaching performances could provide support to the improvement of the teaching practices in the direction of the intended curriculum reform. The case studies were conducted in 1989-1990. Data were collected by means of direct observation of lessons, interviews, textbook analysis, achievement tests analysis and by administering a student questionnaire.

Kumar, David

Strand 5

Sun, 23 Apr, 1995
1:00 PM
Suite 2601

Computer Technology and Science Assessment: A Research and Development Perspective

Stanley Helgeson Donna Berlin Arthur White James Altschuld Nancy Romance
Michael Vitale Arthur White

How computer technology might be used in science assessment is the focus of this symposium. Computer-based assessment is said to have started a new approach to testing in science. Has it? If not, are testers simply reproducing old practices in a new technology? If, computer-based assessment in science were to contribute to new levels of learning, what new findings from cognitive theories of learning ought we employ? Who is doing the best kind of new thinking about this matter? Do we have some kind of empirical base? Any research findings so far? To answer these questions the symposium addresses research and developments in computer-based science assessment with the foregoing topics, including both theoretical and practical aspects of computer-based assessment: Computers in science assessment; past, present and future; Role of computers in assessing integrated science and mathematics learning; Teacher advocacy of testing policy in the role of technology in science assessment; and Program evaluation concerns of computer-based science assessment. Also the symposium addresses the issues in computer-based science assessment.

Kurth, Lori A.

Strand 2

Sun, 23 Apr, 1995
10:30 AM
Gold Rush A

Dynamics of Scientific Design and Explanation in Middle School Collaborative Groups

Charles W. Anderson Annemarie Palincsar

Collaborative groups appear to be an appropriate place for students to share their developing knowledge and work together to deepen and further their scientific understandings. In studying collaborative groups in middle school science classrooms, we had hoped that all students would have the opportunity to engage in critical elements of scientific discourse, design and explanation. Students were engaged in a course of study that introduced and developed rich activities in kinetic molecular theory. Data analyzed included videotapes of small group work which were coded to determine patterns across groups. These analyses were compared against our previous work with case studies to determine the extent that trends prevail in all the small groups. We found that students of various academic abilities engage successfully in design activities, but explanation activities would often be dominated by an academically successful student. In attempting to understand why the less academically students did not engage in explanation activities, we believe that students' comfort and engagement in scientific discourse can be better understood when considering the totality of their experience including their personal associations and connections with scientific activities.

Kyhl, Caroline S.

Strand 1

Sat, 22 Apr, 1995
8:30 PM
Emerald

The Development of Classification Structures within the Period of Concrete Operational Thought

The purpose of this study was to establish whether or not there is an hierarchical order of attainment of the four classification structures which Piaget proposed in his logico-mathematical model for intellectual development. The relationship between performance on classification tasks and grade level and the relationship between task performance and gender were also investigated. The four mental structures examined are constructed during the Concrete Operational Period and pertain to an individual's actions performed on objects in order to logically form classes with the objects. The development of classification structures is germane to the field of science education, because of the connection between classificatory behaviors and reasoning in all science fields. Piagetian-type performance tasks for each of the classification structures were administered in individual interviews with 104 elementary, middle and secondary school subjects between the ages of 8 and 18. Statistical analyses revealed a developmental sequence of acquisition among the four classification structures. Chi-square analyses showed a significant relationship between task performance and grade level, but no significant relationship between task performance and gender.

Larson, Jane O.

Strand 5 — Sun, 23 Apr, 1995 1:00 PM Suite 2625

For All Intents and Purposes: Probing the Levels of Intended Curriculum for a High School Chemistry Class

The purpose of this study was to compare and contrast significant features of the multiple layers of policy statements and objectives comprising the intended curriculum of a chemistry class. Levels of this curriculum include state, district and local school science curriculum policies as well as those of curriculum developers and teacher. An additional objective was to determine the relative influence of each level upon the teacher and his subsequent implementation. Using data collected in a year-long ethnographic study of curriculum modulation, a matrix was constructed to form a composite of the levels in terms of objectives, recommended instructional methodologies, theoretical perspective, conception of curriculum and science curriculum emphasis. Preliminary findings suggest areas of inconsistency and contradiction between and within the levels, creating an uncoordinated system of intent. It was found that the teacher chose to ignore the outer layers of intended curriculum and implement the chemistry curriculum according to personal objectives with some input from the text and associated materials.

Lavoie, Derrick R.

Strand 7 — Sun, 23 Apr, 1995 1:00 PM Portola

Use of Telecommunications to Deliver University Science Content/Education Courses to High School Science Teachers: An Evaluation

The purpose of this evaluative study was to determine the effects of teaching university science content/education courses to high school science teachers via computers and modems. A user-friendly menu-driven software conferencing system allowed instructors to engage the participating teachers in learning activities characteristic of an actual classroom such as posing and responding to questions, disseminating information, handing in work and receiving feedback. Instructor interviews and participant surveys were conducted to assess attitudes and learning outcomes relative to the course delivery, the effectiveness of the electronic medium and participant/instructor interactions. Overall, the courses were viewed as worthwhile by the participant and instructors. Both instructors and participants experienced a brief frustration period at the beginning of each course while learning to use the electronic medium. As the courses progressed, instructor roles became increasingly facilitative, with cooperative learning and inquiry questioning becoming predominant instructional strategies.

Lavoie, Derrick R.

Strand 7 — Sun, 23 Apr, 1995 8:30 AM Portola

NARST-net: A Training and Discussion Session

Joe Peters

NARST-net is becoming increasingly valued by NARST members as a daily means for communication. The current Listerv mailing list exceeds 350 members and is growing steadily. Furthermore, as new members connect to the Internet, they need to become aware of its potential for communication. This two-hour interactive session will review the current Listserv application (signing on and off, viewing and posting messages, auto-deletion) as well as explore new applications. Participants will receive hands-on demonstrations of the Listserv as well as accessing the NARST Gopher server. Discussions will focus on the use of NARST-net for an electronic journal, electronic newsletter, on-line networking groups, resource compiling and science education electronic conferences. Join us and become a part of the "Information Super-highway".

Lawrence, Chris

Strand 10 — Tue, 25 Apr, 1995 2:30 PM Emerald

Historical Reporting of Teaching-learning Experiences in Iowa SS & C: A New Type of Teaching Module

Robert Yager

This case study will portray the many facets involved in the development of a new type of module in the Iowa SS&C project. The melding of action research with module development has resulted in exemplars, historical reports of teaching experiences, that depict major aspects of the Iowa SS&C framework and other national science education reform efforts. These exemplars, as a set, represent the basic framework of a module and include the following: (1) conceptual webs representing an overview of the structure and major themes of an entire 3-6 week experience, (2) unit rationales connecting learning goals, (3) in-depth narratives of students' experiences, (4) in-depth reports of student led investigations, (5) resources in the community and, (6) explanations of national science reform assessment standards and how they were met. These modules serve as a means of passing on what these teachers know about teaching-learning and preserve much of the complexity of teaching-learning experiences.

BEST COPY AVAILABLE

Lawson, Anton E.

Strand 5 — Sun, 23 Apr, 1995 1:00 PM Suite 2625

Using Learning Cycles to Teach High School Chemistry

James P. Birk Andrew Mazzolini

The purpose of this study was to evaluate the effectiveness of a series of learning cycles to teach basic chemical concepts, develop student reasoning skills and improve student attitudes toward chemistry in high school chemistry courses. Thirty-two high school Chemistry teachers took part in two summer workshops in which the learning cycle method of instruction was introduced. The teachers then assisted in the development of 35 learning cycle based lessons and subsequently used them in their courses. Courses taught by other teachers in the same schools served as controls. A total of 1084 students comprised the experimental group taught with the learning cycles; the control group contained 997 students. Posttests administered during the third month of the second semester revealed small but significant differences in favour of the experimental group on all three measures (concepts, reasoning and attitudes). Experimental group students did significantly better on the concepts test in spite of the fact that their teachers "covered" fewer topics than did the control teachers. Number of topics ranged from six to eleven with optimum performance at eight topics introduced.

Lederman, Norman G.

Strand 8 — Tue, 25 Apr, 1995 8:30 AM California

Translation and Transformation of Teachers' Understanding of the Nature of Science into Classroom Practice

The purpose of this multiple case study was to investigate the influence of teachers' understanding of the nature of science on classroom practice and to delineate factors which facilitate or impede this influence. Five Grade 10 Biology teachers constituted the sample for this year-long investigation. A combination of semi-structured interviews, open-ended questionnaires classroom observations, instructional plans and materials, periodic informal interviews and student interviews served as sources of data. Using analytical induction, data sources were viewed independently and together in order to triangulate data while constructing teacher profiles. The results indicated that teachers' conceptions of the nature of science do not necessarily influence classroom practice. Of critical importance were teachers' level of experience, intentions, perceptions of students and beliefs about Biology/Science instruction. Further, although certain activities model the nature of science, such activities do not result in development of students' conceptions without an explicit attempt by the teacher to address the nature of science. The results have critical implications for preservice/inservice teacher education as well as the successful implementation of current reforms that strongly emphasise the nature of science.

Lederman, Norman G.

Strand 8 — Sun, 23 Apr, 1995 8:30 AM Crystal

Can There Be a Universal Science in Our Multicultural World?

Mary Atwater Nancy Brickhouse William Stanley Cathleen Loving
Denis Phillips Ron Good

Interest in "multicultural science" is steadily increasing and has become more prominent in the science education literature. Many scholars have criticized the current science curricula (as well as the science advocated in the reforms) as presenting only "Western Science" or presenting the view that there is only one science. Alternatively there are just as many scholars who take the position that science has only arisen once in history and, that the various culture-specific activities performed throughout the world, (and throughout history) that have also been labeled as science, are actually either technology or something other than science. Although few would argue that science is not influenced by the culture within which it is practised, there is much debate whether this influence constitutes different ways of knowing or simply cultural infusion.

Lee, Kwan-Min

Strand 6 — Mon, 24 Apr, 1995 10:30 AM California

Schooling Experiences of Black South African Students: A Case Study

Using the phenomenological approach (Schultz, 1967), six College of Science students were interviewed in-depth about their past schooling experiences and their current experiences in the university. The purpose of this project was to understand what it meant for these students to succeed in a traditionally white university. Their stories were told in the profiles (cf. Seidman, 1983) constructed based on their own words. Important themes (cf. Hollingswoth et al, 1993) in the form of significant events as shared by these students were also identified.

Lehman, James D.

Strand 7 — Mon, 24 Apr, 1995 4:00 PM Portola

An Examination of Science Teachers' Use and Perceptions of Interactive Videodiscs in the Classroom

Dianna Brickner

This evaluation study was designed to investigate teachers' methods of using interactive videodiscs in the science classroom, their perceptions of the technology and evidence of its impact. Thirty-six K-12 teachers participated in inservice training on the use of interactive videodiscs in the science education and then integrated interactive videodisc activities into their classrooms. Data from teacher questionnaires, usage logs, classroom observations and interviews as well as student attitude and performance data were collected. Considerable variability in classroom usage was found. Teachers perceived the technology to be motivational and beneficial for student learning and student results were positive. However, lack of time and limited equipment availability were identified as limitations or barriers to usage. Suggestions for implementing interactive videodisc technology in the classroom emerged from the findings.

Lennon, Alan

Strand 2 — Sun, 23 Apr, 1995 8:30 AM Emerald

The Interactions of Spatial Perception, Spatial Orientation and Spatial Visualization with Achievement in Microbiology

Margaret E. Heimbrook April L. Gardner

This study examined the relationships between three spatial abilities and achievement in a college junior-level microbiology course (n=82). Using stepwise multiple linear regression, spatial perception, spatial orientation and spatial visualization were examined along with other variables to determine their usefulness in accounting for the variances in overall course grade, final exam grade and lab grade. Analyses were performed separately for males and females due to known sex differences in spatial abilities. For males, spatial perception and spatial visualization together accounted for 37% ($p < .02$) of the variance in lab grade. There were no gender differences, however, in microbiology achievement. While other abilities and strategies are being studied to determine their efficacy in predicting success in microbiology, these results indicate that spatial ability is a better predicting variable for males than for females.

Lewis, Eileen

Strand 7 — Mon, 24 Apr, 1995 8:30 AM Portola

Longitudinal Assessment of Conceptual Understanding and Its Relationship To Epistemological Views

This study presents longitudinal data on the persistence and participation of students in Science classes. It uses case studies (N=33) to characterize students' reasoning about scientific principles, to describe their beliefs about the nature of science and themselves as science learners and to follow their participation and success in science classes. These case studies begin in the first semester of Grade 8, and continue through students' senior year in high school, a period of almost five years. Case studies were constructed using analysis of clinical interviews, open ended prefests and posttests, as well as student's participation in learning experiences. The case studies demonstrate the effect of a lack of integration of everyday and scientific reasoning on the growth of both conceptual and epistemological ideas. The data also suggest how instruction can build on student's intuitive ideas to promote robust knowledge as well as more productive views of science as an enterprise. Further, the data give insights into effective methods for learning science.

Lii, Bor-Wei

Strand 10 — Mon, 24 Apr, 1995 8:30 AM California

Elementary and Middle School Students' Image of Science and Scientists Related to Current Science Textbooks

Hsiao-Ching She

The purpose of this study was to examine different grade level students' image of science and scientists and connection with current science textbook. The modified Chambers' Draw a Scientist Test (DAST) procedure was administered to elementary school Grades 1, 3, 5 and middle school Grade 2 (Grade 8) for a total 289 students in Taiwan, R O C. Results showed that students drew more indicators as they progressed into higher grade levels. In addition, more students in higher grade levels drew scientists wearing lab coat, eyeglasses, with facial features, symbols of research, symbols of knowledge and relevant captions than lower grade students. Moreover, the analyses of individual students drawings revealed an increase in sophistication and complexity across the four grade levels. Students very often drew what their science textbook presented, which supports that our current science textbooks indeed have some degree of influence on students' image of science and scientists.

Lim, Siew-Bee

Strand 4 — Mon, 24 Apr, 1995 10:30 AM Gold Rush B

Changes in Attitudes Towards Professional Upgrading of Primary Science Teachers in Brunei Darussalam Following an Eight Week Inset Program

Philip Adey

This paper will report one aspect of a project looking at the long-term effectiveness of an intensive centre- and school-based inservice programme designed to change Bruneian primary teachers' science teaching methods. The development and validation of an attitude questionnaire which has scales for Confidence as a science teacher; Professionalism; and Receptivity to upgrading, will be described and implications drawn for desirable characteristics of future inservice courses.

Lin, Huann-Shyang

Strand 4 — Sat, 22 Apr, 1995 8:30 PM Emerald

The Development of Beginning Chemistry Teachers' Teaching Techniques

The purpose of the study was to investigate the development of beginning Chemistry teachers' teaching techniques. Each of the 15 participants was observed and videotaped 50 minutes at the beginning of the first year teaching and 50 more minutes at the end of the year. Questioning skills and teaching performance were analyzed. It was found that the beginning Chemistry teachers made progress significantly on asking divergent questions, using wait time and overall teaching performance. However, they seem to have difficulty in using analogies to clarify science concepts and initiating classroom discussions. In addition, the beginning Chemistry teachers tended to ask their students to memorise the science content knowledge and formulas in the textbook.

Lin, Sheau-Wen

Strand 3 — Sun, 23 Apr, 1995 8:30 AM Carmel

Biology Teachers' Knowledge Base of Instructional Representations

Jong-Hsiang Yang

The purpose of this study was to identify the knowledge base that contributed to the Biology teachers' instructional representations. Participant observation, interview and various related documents were used to collect data from four exemplary junior high school Biology teachers. Analysis indicated that the knowledge base of their instructional representations consisted of five major categories: knowledge of subject matter, students, curriculum, context and forms of representation. Each category had several chief subcategories. These categories overlapped and interacted with each other. The knowledge base of their instructional representations made them teach effectively.

Lindauer, Ivo E.

Strand 4 — Tue, 25 Apr, 1995 1:00 PM Nevada

A Profile of Biology Teachers in the USA

Mary Queitzsch

A profile of public school biology teachers (Grades 7-12) in the United States will be presented. The 1990 - 91 Schools and Staffing Survey (SASS) database was the source of the information. Descriptive statistics are used. Variables of gender, ethnicity, age, type of degree, main and secondary teaching assignments and locale were used for comparison of Biology teachers to other science teachers. Each of the variables were presented in two separate groups; Grade 7 and 8 Science teachers and Grade 9 through 12 Science teachers.

Linn, Marcia

Strand 7 — Sun, 23 Apr, 1995 12:30 PM Crystal

Computer as Learning Partner: A Retrospective, Part I

Phil Bell Helen Clark Elizabeth Davis Brian Foley Christopher Hoadley Sherry Hsi Eileen Lewis Jacquie Madhok Lawrence Mullenberg Rick Weinland Judy Stern Carl Berger (continued below)

In this symposium we describe 10 years of research developing a middle school physical science curriculum called the Computer as Learning Partner (CLP) that has the goal of helping students develop an integrated, coherent view of scientific phenomena. To illustrate how the project evolved, we will start by contrasting video clips from the current classroom with those from the earliest version of the program. A panel of researchers who have participated and advised CLP will discuss technology and instruction in Part I and learning and epistemology in Part II. Panelists will synthesize design principles that could guide use of technology for instruction and illustrate these principles by describing the electronic laboratory notebook, Multimedia Forum Kiosk, thermal model kit and heat bars simulation. In addition, panelists will identify how teachers can use technology to help students integrate their ideas. Topics will include computer modeling environments, electronic notebooks that prompt and help students complete assignments and creative assessment techniques.

Linn, Marcia

Strand 7 — Sun, 23 Apr, 1995 2:45 PM Crystal

Computer as Learning Partner: A Retrospective, Part II

Joe Krajcik Nick Burbules Doug Kirkpatrick John Layman Jim Minstrell Rafi Nachmias Yael Friedler Roy Pea Nancy Songer Bob Tinker Bat Sheba Eylon

This symposium continues the description of 10 years of research, developing a middle school physical science curriculum called the Computer as Learning Partner (CLP), that has the goal of helping students develop an integrated, coherent view of the scientific phenomena. In this session, a panel of researchers who have participated in CLP, will discuss the curriculum and how it incorporates growing understanding of student learning and epistemology. We start with a discussion of the potential goals of the science curriculum, focusing on lifelong learning of science rather than immediate gains in factual knowledge. We describe ways to help students understand energy and its transformations. We posit roles for student views of scientific events, and explain how science activities can help students develop a repertoire of explanations for scientific phenomena linked to problems at varying levels of abstraction. Taking this perspective makes it easier for students to understand the nature of science and to monitor their own learning processes. Specific aspects of the CLP curriculum including, science projects, social support and equity and distributed cognition will be analyzed.

Liu, Chin-Tang

Strand 5 — Tue, 25 Apr, 1995 8:30 AM Redwood

The Effectiveness of the Iowa Scope, Sequence and Coordination Project: A Holistic Teacher Enhancement Study Focusing on Teacher and Student Changes

Robert E. Yager

The failure of past science education reform movements has resided in the implementation phase (Jackson, 1983; Walberg, 1991). The Iowa-SS&C project is an effort to utilize the Science-Technology-Society (STS) approach as well as the Iowa Chautauqua in-service model for improving the science teaching and students' learning in the classroom. To examine the effectiveness of the project, a systematic evaluation of teacher changes and growth in their students has been undertaken. Significant findings can be generalized in terms of changes in teachers and student learning as the followings: (1) teachers gain significantly in terms of their confidence to teach science, (2) teachers gain significantly in their understanding of the nature of science and technology, (3) teachers gain significantly in their understanding of the nature of technology, (4) teachers improve dramatically in their ability to use strategies that can be termed "Constructivist" and, (5) students gain significantly more when experiencing science in an STS format than other students in traditional classes (textbook dominated) in the areas such as concept mastery, science process skills, application of process skills and concepts, creativity skills and positive attitudes toward science.

Loats, James

Strand 4 — Sun, 23 Apr, 1995 4:00 PM Washington

Mathematics Reforms in the Rocky Mountain Teacher Education Collaborative

This paper describes the five year goals and the first year accomplishments in the reform of mathematics majors courses targeted in the Rocky Mountain Teacher Education Collaborative. These revisions are based on the same common reform framework as the science revisions, although the targeted courses in mathematics, unlike Chemistry, are not the same as each institution. At one collaborating institution, the reform targets an upper level course in mathematical modeling and team teaching of the combined mathematics methods and general secondary methods courses (including field placement with outstanding secondary mathematics teachers). At a second collaborating institution, the reform targets include trial sections of a new College Algebra course using a problem solving based curriculum and a problem-based course in higher Geometry. At the third collaborating institution, a Linear Algebra course has been revised.

Lomask, Michael

Strand 5 — Sun, 23 Apr, 1995 1:00 PM Redwood

Beginning Science Teachers and Performance Assessment in Connecticut

Joan Boykoff Baron

In the last four years, the Connecticut State Department of Education (CSDE) has been involved in the development of performance-based teacher assessment in mathematics and science. This paper will describe and analyze findings from the teaching portfolio assessment program during 1993-94. Thirty-two beginning science teachers were asked to document plans and students' work in a lab-centered performance assessment task in their classes. During the winter these teachers participated in four workshops in which they experienced and studied teaching for conceptual understanding the use of performance assessment in science. During the spring, all 32 teachers submitted teaching portfolios that contained the instruction design for a two-week learning unit, videotaped segments of one performance assessment activity and student work on the assessment task along with written commentary. The main findings were: beginning science teachers were able to create/adopt performance-based lab activities that engaged students in experimentation and reflective practice; most performance tasks that were used by beginning science teachers were actually adaptations of exiting lab activities, not all of which were appropriate for use as performance-based assessment; to align new practices of alternative assessment with science education reform goals teachers need support and guidance in: how to develop performance-based assessment tasks; how to read and interpret students' work; how to make assessment an integral part of teaching and how to help students assess the quality of their own work.

Lord, Thomas R.

Strand 6 — Tue, 25 Apr, 1995 1:00 PM Suite 2601

Despite What the Research Suggests, Many Women are as Good as Men in Visual Spatial Aptitude

Two standard measures of spatial aptitude (cube rotation and paper folding) were given to several hundred students majoring in elementary education at a midsize university. The population averaged 21 years of age and contained as many males as female members. The results of the tests were scrutinized by subject matter concentration and sex and compared to national averages for the activities. As expected the men in the study significantly out-performed the women. In addition, the students with science and math specialities did better than students in other concentrations on the spatial tests. However, when the gender-concentration measures were examined together, it was found that the men and women choosing to specialize in science and math scored significantly higher on the tests than their non science-math peers. When the scores of the women in this group were compared to the men, it was found that there was no significant difference between them and their male colleagues. Furthermore, these women scored statistically higher than men in the study not specializing in math or science.

Lorsbach, Tony

Strand 3 — Sun, 23 Apr, 1995, 4:00 PM, Suite 2601

A Critical Perspective on Professional Development in Science Education: A Case Study

This study examines the impact of a two year professional leave by one kindergarten teacher, Pam, to become a teacher trainer for a new hands-on elementary science program adopted by her district. The study uses a critical perspective to examine the growth of Pam from her initial concerns of "teacher training" to her present concern of providing opportunities for teachers to engage in worthwhile professional growth activities that she believes facilitated her own professional development (e.g., engaging in philosophical discussions on the nature of teaching and learning science). In contrast to typical professional development opportunities, this study highlights what is needed for more genuine professional development opportunities in science education as experienced by one practicing teacher, as well as problems encountered along the way.

Louden, William

Strand 1 — Mon, 24 Apr, 1995, 2:30 PM, Nevada

What We Don't Understand about Teaching for Understanding

John Wallace

Teaching for understanding is one of a family of related reforms currently receiving serious consideration by teachers and researchers in the United States and elsewhere in the international educational community. Behind the rhetoric of reform lie a series of unanswered questions about what is meant by teaching for understanding. This study explores some of these questions as they apply in the context of constructivist school science classrooms. Data are drawn from a series of narrative case studies involving extended classroom observation. Several issues emerge from these studies including the role of language, the use of analogies, teaching vs learning for understanding, the use of context and whose understanding counts. We conclude that the practice of teaching for understanding should not be abandoned as a goal but there is much to understand about making teaching for understanding work in science classrooms.

Loving, Cathleen C.

Strand 8 — Sun, 23 Apr, 1995, 10:30 AM, Suite 2601

From the Summit of "Truth" to the "Slippery Slopes": Science Education's Descent through Positivist-Postmodernist Territory

The objective of this research is to seek justification for science educators and the teachers they educate developing informed, balanced views regarding the positivist-postmodernist debate in science education. This is accomplished by clarifying origins and offering details on the current status of these two distinct positions. Inspired by Good's 1993, JRST editorial comment to beware of the slippery slopes of post modernism, I have attempted to modify and broaden the highly focused debates surrounding radical constructivism of von Glasersfeld and the rational realism of Matthews by discussing: (1) origins of important stances, (2) problems with simplistic reductions to two extremes, (3) dubious extrapolations and neglect of primary works, (4) postmodern-positivist debates in the context of other disciplines—such as literary theory and law, and (5) perspectives for science education that might assure a balanced, even-handed approach to positions on the nature of science and the nature of learning science. Using both historical and philosophical interpretations of the issues, I have concluded that current conceptions of both positivism and post-modernism are oversimplified by some who promote the extremes of both relativist and strict, hypothetico-deductive models related to what should be learned.

Lovitts, Barbara E.

Strand 10 — Mon, 24 Apr, 1995, 8:30 AM, Washington

National Science Foundation's Research in Teaching and Learning Program: Where We are Going and How to Get There

The Research in Teaching and Learning program of the National Science Foundation has developed a strategic plan that outlines the program's current funding priorities. This session will be devoted to a discussion of the strategic plan and other related program activities, such as the program's current efforts to develop a handbook of emerging qualitative methodologies. Some of the do's and don't's of writing preliminary and full proposals will be discussed.

Lowery Bretz, Stacey

Strand 1 — Tue, 25 Apr, 1995, 1:00 PM, Portola

Learning Strategies and Their Influence Upon Students' Conceptions of Science Literacy and Meaningful Learning: The Case of a College Chemistry Course for Nonscience Majors

While no consensus exists on the definition of science literacy, at its core is the idea of a scientific knowledge base which must be applied to the personal dimensions of social, economic and political situations. Students must be able to utilize this knowledge to make informed decisions; they must be able to recognize when they need more information, to identify credible sources of such information and to incorporate this new information into their knowledge base. In other words, they must be able to learn meaningfully and to be cognizant of their learning. Meaningful learning is the process by which new knowledge is substantively incorporated into an individual's existing cognitive structures. Hence, knowledge is viewed as a human construction and the business of education is to enable people to construct knowledge. This paper will present conceptualizations of science literacy and meaningful learning as experienced by nonscience majors in an innovative introductory chemistry course designed to teach organic chemistry to the novice through a case-based approach. The implications of these conceptualizations for curriculum development will be discussed.

Lowrey, Kirsten

Strand 10 — Tue, 25 Apr, 1995 1:00 PM Redwood

An Introduction to Critical Theory in Education Research

Dan Machuac

The three knowledge domains of Jurgen Habermas' critical theory are described and their means of generating and warranting knowledge claims is discussed. Related theoretical stances taken by Dewey, Marx and Friere are briefly described. Action research is defined according to the descriptions of Kemmis, Lewin, Rapoport and other educational researchers and a link between Critical Theory and AR is examined. Action research methodologies and role in educational practice are reviewed. Schon's reflective practice is described as a professional analog of critical theory and the fundamental presumptions of critical theory and action research are restated.

Lubezky, Aviva

Strand 1 — Mon, 24 Apr, 1995 10:30 AM Oregon

Students' Environmental Awareness and Their Understanding of Chemistry Related STES Issues

Uri Zoller Yehudit J. Dori

Environmental education (EE) is targeting at preparing environmentally aware, knowledgeable and motivated citizens, who are willing to act for improving the environmental quality of life based on their value system and minimal level of relevant disciplinary and interdisciplinary literacy. We have investigated the EE-oriented entry behavior and the effect an EE-oriented in-service science teachers training and/or chemistry teaching on students' understanding, environmental awareness and relevant higher-order cognitive skills (HOCS). A specially designed "prepost" questionnaire was administered to three groups of pre- and in-service science and chemistry teachers at the Haifa University-Oranim and Technion, respectively. Except for the in-service teachers, the other two groups were not exposed formally to science-technology-environment-society (STES) issues within the courses. Our findings suggest that our students' awareness of environmental issues reflects what they grasp from the media rather than from chemistry classes. They appear, however, to fail recognizing the linkage between these issues and scored low on chemistry-oriented environmental problems which require HOCS capacity for dealing with. A prepost improvement of the HOCS capability was observed, particularly for the students who scored low on the pretest.

Lucas, Keith B.

Strand 2 — Tue, 25 Apr, 1995 8:30 AM Nevada

Students' Perceptions of Senior High School Physics

This study aimed to describe some perception held by senior physics students in two Australian schools in relation to the nature of their physics course, their reasons for enrolling in it and the requirements for success in the course. A case study approach was utilised involving three classes. Exclusive document analysis, gathering of data pertaining to teacher-student relationships and physics laboratory environment and in-class observations preceded semi-structured interviews with students and their teachers. Interviews were transcribed and the transcripts analysed using a strategy which resulted in maps resembling concept maps summarising the main themes discussed. Confirmation of the validity of this analysis was obtained from further consultation with students. Major findings involved a high degree of consistency in relation to the perceptions of senior physics held by the students and their teachers and implicit in school documents. Students found physics to be an interesting and enjoyable subject, which is demanding and highly mathematical, but useful for earning a high university entrance score. There was also consistency regarding assessment practices in physics. The principal requirement was known to be hard work, aimed at understanding the principles of physics in order to memorise formulae and solve mathematical problems successfully.

Lumpe, Andrew T.

Strand 3 — Sun, 23 Apr, 1995 2:45 PM Redwood

Teachers' Beliefs and Their Intent to Implement Scientific Uncertainty in the Classroom

Charlene M. Czerniak

The researchers sought answers to two primary questions: (1) what are science teachers' belief-based affects concerning the implementation of scientific uncertainty in the classroom? and (2) how do teachers' belief-based affects relate to their intent to implement scientific uncertainty in their own classrooms? Scientific uncertainty is cited as part of a definition of constructivism and the nature of science; two components in science education reform documents. The Theory of Planned Behaviour was used to determine K-12 teachers' attitudes toward implementation scientific uncertainty, subjective norm (what others think about scientific uncertainty), and perceived behavioural control (external influences to teaching scientific uncertainty). In a multiple regression model, all three indirect measures, attitude toward the behaviour, perceived behavioural control and subjective norm, significantly accounted for 50% of the variance in the teachers; intention to implement scientific uncertainty in their classrooms (multiple R = .71). It was concluded that if scientific uncertainty is to be included in school reform, these three teacher belief aspects should be carefully considered.

Lunetta, Vincent

Strand 4 — Tue, 25 Apr, 1995 8:30 AM Emerald

Science Teacher Education: Issues for a Contemporary Research Agenda

Thomas M. Dana, Deborah Tippins, Marvin Druger, Mary Atwater, Léonie Rennie

Problems and issues in science teacher education are complex and meaningful progress will be more probable when science teacher education policy and practices are informed by rigorous and relevant research and scholarship. This symposium has been designed to promote dialogue about important questions that should be addressed in science teacher education research and scholarship. Reform issues involving equity, diversity, ethics, curriculum standards, certification, supervision, school-university and intra-university partnerships, are very visible in the contemporary education literature and have implications for science teacher education research. Reform of science teacher education delivery systems and institutions is implicit in Holmes Group and accreditation initiatives and in the gulf that continues to separate many in the science and science education communities. This symposium panel includes persons in the science education community with special expertise in the following specific issues: gender equity, multicultural equity, bridging the gulf between science and education communities, bridging the gulf between preparing institutions and schools and promoting enlightened policy. Each will present a provocative, yet brief position statement outlining perspectives on research needs, opportunities and resources in science teacher education research. A central question guiding the discussion that will follow in these brief presentations shall be: How can these needs and perspectives be studied and applied in research on the education of teachers of science?

Lynch, Sharon J.

Strand 4 — Sun, 23 Apr, 1995 2:45 PM Washington

The Missing Link: The Implemented Curriculum in Project 2061

This study centers on preparing pre and inservice teachers to teach Project 2061 science. To date, science education reform efforts have focused mainly on intended curricula (goals, standards, frameworks, etc.) and outcome based measures (assessments). The implemented curriculum—the way teachers plan to teach—has received less attention. In this Project, 21 pre and inservice science teachers analyzed the materials of Project 2061 including the 800+ student Benchmarks, developed a set of 60+ teacher implementation indicators, designed two-week interdisciplinary science units based on these materials and evaluated their units using the set of teacher indicators. This is a promising way to introduce teachers to Project 2061 in an indepth fashion and to produce a tool with which they will be able to evaluate their planning and teaching.

Lynch, Sharon J.

Strand 6 — Sat, 22 Apr, 1995 7:00 PM California

An Equity Blueprint for Science Education Reform

Jaquelynne Eccles, Mary Atwater, Okhee Lee, Abbie Willetto, Jack Cawley, Doreen Rojas-Medlin

The Equity Blueprint address AAAS's Project 2061 K-12 science education reform efforts. The focus is to explore the implications of Project 2061 on various groups of students who presently: are under-represented in science classes and science related careers; do not achieve highly in science; have difficulty getting access to appropriate learning environments for science; and may not match current stereotypes of a "sciencey" sort of student. We also consider students from groups who have traditionally done well in the sciences in the United States (some Asian Americans and gifted and talented students) and attempts to assess how Project 2061 science affect them. The purpose of this Equity Blueprint is; to summarize the barriers to equity in science achievement; to review upon current promising practices; to reflect how Project 2061's goals may affect science achievement; and, to determine short-and long-term agendas for science equity. The members of the Equity Blueprint Committee are experts in science education and equity issues, specifically gender, African Americans, American Indians, Asian Americans and English Language Learners, as well as rural populations (which can cut across all categories) and special education populations—students with mental disabilities, those with physical disabilities and the gifted and talented.

MacIsaac, Dan

Strand 10 — Tue, 25 Apr, 1995 1:00 PM Redwood

Curriculum Reformation in Undergraduate Physics Laboratories via Action Research

A dissertation study employing action research (AR) methods and conducted over four semesters of practice in a large scale (2000+ students/year) first year undergraduate physics laboratory will be described. Three cycles of AR will be recounted, along with the resultant changes in goals, methodologies and curricular practices. The data collection and analysis techniques and emergent knowledge claims of one cycle of AR will be described in detail. This cycle included the pursuit of ten students through the course by open-ended interviews, commentary, user observation protocols and artifact analysis. The various curricular and instructional changes resulting from study findings will be enumerated and briefly reviewed.

MacKinnon, Allan

Strand 4 | Sun, 23 Apr, 1995 8:30 AM Washington

A Description and Analysis of Techniques Involving an Interactive Video Lab School for Science Teacher Education

The problem addressed in this research program is: How can institutional support for primary and intermediate teachers be orchestrated to enhance the development of continual learning and inquiry about the teaching of science? Set in the context of the teacher education program at Simon Fraser University, this project documents aspects of teacher education that are designed to promote *reflective teaching practice* and analyzes the developing knowledge-base of participants involved in these experiences. This research program has created and investigated a "continuum of teacher development" in science teaching, in which preservice teacher education, inservice professional development and graduate programs in science education were orchestrated to run in concert, where appropriate, with the view that the various factions of teacher development along this continuum would enhance one another vis-á-vis their interaction. This paper reports on an extension of this program involving teachers and school children across the province through microwave and broadband interactive video—essentially, live audio and visual communication at a distance.

Magnusson, Shirley

Strand 7 | Sun, 23 Apr, 1995 4:00 PM Portola

Unexpected Consequences of Using Technology to Help Elementary School Students Understand about Sound and Music

Danielle Ford | Mark Templin | Annemarie S. Palincsar

Considering that individuals actively construct meaning from their experiences, it is important to examine how students construct meaning while using technology. In particular, we are concerned with two principles illustrated by the Generative Learning Model: the dependence of meaning construction on *selective attention and prior knowledge and experiences*. We examined students' understandings from the use of two software programs intended to help them learn about sound and music. The students were from a Grade 4 class in a school that primarily serves the working-poor, as part of a program introducing an innovative approach to teaching science. Findings indicated that the development of understanding was influenced by the principles listed above. When using software that emulated an oscilloscope, students found amplitude differences much more salient that wavelength differences, which were the intended focus. When using a program that turned a computer into an electronic keyboard, students seemed to lack sufficient experiences to make use of the information from the program, which was intended to support them in constructing instruments that could play a major scale. These findings indicate that there is important knowledge to be identified to help teachers plan instruction that can maximise the potential technology to facilitate learning.

Maor, Dorit

Strand 7 | Tue, 25 Apr, 1995 2:30 PM Portola

How Can We Use a Computerised Database to Enhance Students' Understandings in the Science Classroom?

A new version of a scientific database was developed to enhance students' inquiry skills and higher-level thinking skills in the science classroom. A subsequent interpretive research study found that interaction with the computerised database in a constructivist learning environment provides students with enhanced opportunities to construct inquiry skills and high-level thinking skills (Maor, 1993). This demonstration session will introduce the new scientific database which contains information collected during research expeditions to Antarctica as late as 1993. This will be followed by a discussion based on the research study on how to facilitate students' engagement in high-level learning in science classrooms in which the teaching-learning process includes students interacting extensively with personal computers and teachers adopting a constructivist epistemology to teach.

Marencik, Joseph

Strand 1 | Mon, 24 Apr, 1995 4:00 PM Nevada

Conceptual Change in Understandings of Electricity: A Comparison of Instructional Sequences with Voltage vs. Current as the Initial Concept

John Settlage

Whether the concept of current or the concept of voltage should be the first taught to high school students has been debated in the literature for over a decade. In this study, we developed a unit of instruction about electricity using the Learning Cycle model. Both sections of an Honors (Grade 9) Physical Science course worked through identical in-class activities and homework assignments. The only difference in the instruction for the two groups of students was whether the concept of voltage was taught before or after instruction about current. On the end-of-the-unit test, students who studied voltage and then current had significantly higher scores than the students who studied current followed by voltage. Students were administered a two-tier test about electricity several months after instruction and the differences in understanding as measured with this instrument persisted ($p<0.001$). No significant relationships were found between an understanding of electricity and students' pre-instructional familiarity with electricity nor with their level of cognitive development.

Mariani, Maria C.

Strand 1 — Sun, 23 Apr, 1995, 8:30 AM, Redwood

Pupils' Commonsense Ideas about the Construction of Knowledge

This preliminary study concerns the discussion of pupils' ideas about the coordination of evidence and measurement with theories or models in the construction of knowledge, with the general purpose to describe an "epistemology of commonsense reasoning". A small scale experimental research has been conducted with this purpose in mind. Several questionnaires were designed and given to small groups of high school pupils in Sao Paulo, Brazil (five different kinds of questionnaires given to N: 33; 46 (pairs); 33; 25; 23; total: 160; ages: 16-18 year-olds). The analysis of data was mainly qualitative of the responses obtained; only one questionnaire was designed with the purpose to obtain quantitative information with the use of a Principal Components Analysis. The quantitative results indicate the presence of at least three relevant dimensions of commonsense thought about the construction of knowledge: speculative against evident knowledge; beliefs against theories; and irrefutable against empirically provable. The qualitative analysis gave some more support to these findings. This work was supported by CNPq.

Marion, Scott F.

Strand 5 — Sun, 23 Apr, 1995, 4:00 PM, Oregon

Equity Issues for Large-scale Performance Assessments: An Analysis of Gender and Race Differences

Lorrie A. Shepard

This study examines the student performance by race and gender for three years on a state science performance assessment. Preliminary analyses indicated that difference between whites and blacks, favored whites by approximately three-quarters of a standard deviation. However, girls scored higher than boys each year and for all three grades assessed. While these gender differences were relatively small (ES ranged from .1 to .25), the consistency of the pattern (favoring girls), especially as late as middle school grades, is fairly unusual. As many as 25% of the schools have results contradicting the state trends. We are exploring factors to help explain why certain schools are able to reduce gender and ethnic differences while the scores diverge in other schools. Our last line of inquiry focuses on differences among process strata within the science assessment. That is, race and gender differences on traditional content such as "concepts of science" may not mirror the pattern found on newer content and processes which are more closely aligned with the current science reform efforts (e.g. "Process of science"). We will be investigating whether or not certain task features such as writing demand and "open-endedness" are correlated with the variability in the pattern of race and gender differences across content domains and intellectual processes.

Marlow, Michael P.

Strand 2 — Mon, 24 Apr, 1995, 4:00 PM, Suite 2601

Research in the Classroom: Implementation of a Regional Program

Stacey E. Marlow

The purpose of this study is to examine student and teacher involvement in an integrated science research program that uses active learning techniques, co-operative learning and teacher facilitation to investigate real life problems. Twenty-eight classrooms, grades three to twelve, in ten school districts in Michigan are participating in the programme. Curriculum documents, student written materials, field notes from observation and interviews with students and teachers formed the database for this study. Three questions guided the research: (1) did the use of authentic research motivate students to expand their interest in scientific inquiry, (2) what were student's views about knowledge in the classroom e.g. it's nature, creation and use, and (3) what impact(s) does the integrated science programme have on the teacher's approach to instruction? The findings indicate a much greater overall impact on the elementary classrooms than the secondary classrooms. Students in the elementary classrooms were more involved, asked questions that led to deeper understanding and further investigation and generally pursued a more holistic approach to the topic. Secondary teachers were resistant to topic integration, stressing concern with time spent on "irrelevant topics". Entire elementary classes centered much of their curriculum on the research topic whereas only individual or small groups of students in the secondary classrooms became seriously involved, generally pursuing additional information outside the formal curriculum. Most of the secondary teachers tended to adhere strictly to the assigned research and rarely encouraged a broadening of the topic.

Marlow, Stacey E.

Strand 6 — Sat, 22 Apr, 1995, 7:00 PM, Monterey

The Effects of Participation in a Math and Science Mentorship and Career Awareness Program on Middle School Girls

Michael P. Marlow

This study examined the effects of participation in a math and science mentorship and career awareness program on 320 middle school girls. Using a combination of quantitative and qualitative data, the researchers examined students' attitudes about studying math and science in high school, their awareness of math - and science - related careers and changes in students' perceptions about themselves as learners and knowers in the math and science arena. The findings indicated that while there were statistically significant changes in the girls' awareness levels about math and science related careers and in their intentions to take more math and science courses in high school, the girls perceived themselves as receivers, rather than constructors of knowledge.

BEST COPY AVAILABLE

Martinello, Marian L.

Strand 4 — Sun, 23 Apr, 1995 10:30 AM Monterey

Changing Preservice Teachers' Perceptions of Scientific Inquiry

This study explores the effectiveness of an undergraduate course on diversity of thought in developing preservice teachers' concepts of scientific inquiry. Subjects included 100 students enrolled in three sections of a required course entitled Modes of Inquiry Across the Fields of Study and an equal number of control students who had not yet completed the course. The experimental group experienced a four week unit of study on scientific inquiry which examined ways of thinking reported by scientists and analysts of scientific inquiry. All sections were taught by different faculty following the same syllabus and using the same instructional materials, including CD-ROM and video presentations. A 30-item survey measuring perceptions of scientific inquiry, with a Likert response scale, was used in alternative forms for pre-surveys before and after beginning a unit on inquiry in science and at the end of the term. Preliminary item analyses suggest that subjects' perceptions of scientific inquiry may be moving toward greater awareness of differences in experimental and theoretical methodologies and the influence of content and context on scientific thinking.

Martinez, Michael E.

Strand 5 — Mon, 24 Apr, 1995 2:30 PM Portola

An Analysis of Student Outcomes Related to Integrated Science and Mathematics: A Reductionist Canonical Approach

This study is part of a three-part project designed to explore the nature of student outcomes related to participation in integrated science and mathematics activities in different cultural settings. Four teachers in Grades 4, 5 and 6 observed their students during integrated activities and recorded student outcomes and evidence in Classroom Observation Journals. The purpose of this study was to code, sort and classify the student outcomes according to category, frequency, intensity and source of evidence. A total of 320 student outcomes were generated. Outcomes judged as irrelevant, vague or trivial were eliminated, resulting in an analysis of 242 outcomes. The outcomes were reformulated and after a series of data reductions, six canonical categories were identified in a taxonomic schema. These include: science and mathematics concepts and processes, cooperation, positive motivation/emotion, thinking skills, relevant and discouragement. The first three clusters of outcomes were most frequently reported. A chi square test of independence showed that for clustered outcomes the four sites differed significantly. These results will be combined with those of another external researcher and further analyzed according to ethnicity to guide in the development of an integrated science and mathematics assessment package that is culturally sensitive and responsive.

Mason, Diana

Strand 1 — Sun, 23 Apr, 1995 4:00 PM Suite 2625

Assessing Student Problem Solving Success on Selected Topics in Introductory Chemistry

The aspects of problem solving studied were the differences in the problem solving strategies used by novices (n=20) as they solved paired algorithmic and conceptual problems on selected topics: density, stoichiometry, bonding and gas laws. Data were gathered from the interpretations of incident identification graphs drawn at the time of the think-aloud interviews of novices and experts. Novices were placed in appropriate problem solving categories dependent upon their success rate in each problem mode. Differences detected in subjects' problem-solving schema (read, define, set up, solve and check) were evaluated in terms of the time needed to complete a solution, the number of transitions required and the rate of transitions over time. Results indicated that low algorithmic/low conceptual problems solvers exhibited greatest difficulty in finding solutions to stoichiometric problems and regardless of topic, the time required for a novice to solve an algorithmic problem exceeded the time needed to solve the paired conceptual problem.

Mastrilli, Thomas M.

Strand 1 — Sat, 22 Apr, 1995 8:30 PM Emerald

Can Information Processing Approaches to Learning be Informed by Vygotskian Theory? Potential Interactions

The purpose of this survey was to answer the question: Can information processing approaches to learning be informed by Vygotskian theory? A secondary objective was to identify how these component interactions might manifest themselves as effective practices within the science classroom. Possible models of teaching are also discussed. The procedure employed was a survey of the literature associated with particular components of the respective theories. Six components of learning that may have value in illuminating how information processing and Vygotskian theory could merge are identified. The six components are: (1) individual cognition with cooperative learning venues, (2) concept acquisition, (3) use of symbols, (4) use of "bridging analogies", (5) capacity for imitation and mutual regulation and, (6) use of computers in the classroom for diagnosis and reflection.

Matson, John O.

Strand 10 — Tue, 25 Apr, 1995, 8:30 AM, Monterey

The Art of Reflecting in a Two-way Mirror: A Collaborative Autobiographical Study by Three Science Educators

Sharon Parsons Jim Rohan

Recent research has focused on the use of reflection to examine teaching practice of preservice and inservice science teachers. Limited research however has been done by university science educators on their own practice. This study involved university science educators collaboratively participating in such an activity with an inservice teacher. It utilized narrative inquiry to examine the practice of the three science educators. Specifically it used one form of narrative inquiry, namely autobiographical analysis. Autobiographical analysis is a useful methodology for self-reflection. In the study two science educators (university science educator and a K-12 science teacher) reflected on the influence of constructivism on their practice while the third reflected her practice from a postmodern feminist perspective.

Matthews, Michael R.

Strand 8 — Sun, 23 Apr, 1995, 4:00 PM, Crystal

Panel Review of "Science Teaching: The Role of History and Philosophy of Science"

Norm Lederman Cathleen Loving Denis Phillips

This session will consist of a panel of three reviewers — Norman Lederman, Cathleeen Loving and Dennis Phillips — who will each comment on a different aspect of Michael Matthews' recently published book Science Teaching: *The Role of History and Philosophy of Science*. The author will respond to the reviews and then audience discussion on the book will be encouraged. This will include some accounts of how the book has been received in undergraduate and graduate science education classes.

Mattson, Sue

Strand 1 — Sun, 23 Apr, 1995, 7:00 PM, Exploratorium

Videos of Case Studies: Issues Involved in the Development of Images for Science Teacher Education

The Case Studies Project in Science Education is creating 25 half-hour videotapes each centering on the story of one teacher's approach to a problem s/he has encountered in science teaching and learning. Working with science educators experienced in teacher education, teachers negotiate and implement strategies that can be applied to their specific problems and evaluate the results as they bring them back to their classrooms. Each case is meant to highlight the types of problems and strategies that are at the heart of science education reform, and to emphasize that there are no easy solutions to complex problems. While the primary goal of this project is to create visual models of science education reform to provoke discussion and critical analysis by the audience, the process of making highly edited videotapes raises several methodological and ethical issues. In particular, there are questions about the extent to which contemporary approaches to research involving case studies might — or must — be involved in the production of materials for science teacher education. This session explores these issues and their implications for this and other projects that are using this potentially powerful medium to further goals for science education reform.

Mayer, Jürgen

Strand 5 — Sun, 23 Apr, 1995, 8:30 AM, Suite 2625

Teaching Biodiversity: Results of a Delphi Study in Germany

The empirical curriculum study focuses on biodiversity. Seventy-seven persons, e.g. scientists, teachers and students were questioned about the reasons, goals and contents of teaching biodiversity using the Delphi method. The answers were grouped into 47 categories and summarised into five curriculum themes by cluster analysis: (1) unifying principles in nature's diversity, (2) systematics of biodiversity, (3) ecology and maintaining biodiversity, (4) economics and biodiversity and, (5) enjoying biodiversity. All participants judged the themes to be of great importance for biodiversity literacy. Ecology and maintaining biodiversity in particular was considered of highest importance. The results indicate that the exploration of biological diversity focused not only on taxonomy and systematics; the results reflect the necessity to view biodiversity in contexts that have personal, social, ethical and especially ecological meanings. Instruction should be an active process, in which students observe, explore, name, understand and value biodiversity. The study of biodiversity should include numerous experiences with living organisms.

Mayer, Victor J.

Strand 5 — Sat, 22 Apr, 1995, 7:00 PM, Washington

Science Is: Understanding Planet Earth

Rosanne Fortner Tung-Huang Hsueh Mark Maley Ronald Pilatowski
Dan Jax Melinda Wilder Richard W. Pontius

We are engaged in a massive science education restructure. This at a time in which we find ourselves at a unique crossroads in American and world history and consequently the development of American science. Since the early 1900's science has been based on a "war economy". We have seen Federal Policy support an ever increasing growth of science for military applications. This has deeply colored the science we teach for "All Americans". Science curriculum and its mode of delivery has closely reflected these federal priorities. It is time for a fundamental change in the product and process of science curriculum. This representation will provide a rationale for such fundamental change and report on evaluation results of efforts at middle school, high school and university levels to facilitate such change including the development of a truly new integrated science curricula in schools representing ten mid-Ohio school districts and preservice and inservice teacher preparation programs designed to assist teachers to develop and implement such curricula. The curricula are based on the investigation of our earth system and its environs in space as the central organizing conceptual theme and use cooperative or collaborative learning modes.

Mayer-Smith, Jolie A.

Strand 1 — Tue, 25 Apr, 1995, 1:00 PM, Emerald

Science Meets Education: Interfaculty Collaboration to Implement Change in a Large Undergraduate Problem Solving Course

Anthony J. F. Griffiths

This study explores what can be learned and accomplished if faculties of science and education work collaboratively with the goal of improving teaching and learning in undergraduate science. The context was a required third year genetics course with an enrolment of 500 undergraduates. Discussions concerning significant learning difficulties students experienced when solving genetics problems initiated two professors, one from Science and one from Education to design a project to enhance genetics teaching and learning. Professors and teaching assistants involved in the course instruction met weekly throughout the semester with the education faculty member to identify context specific learning problems and to design and discuss the implementation of innovative strategies for genetics instruction. Information collected through student questionnaires, instructor interviews, meeting transcripts and observational records by the project designers contributed to an understanding of students' difficulties in learning genetics and the barriers associated with implementing change in a large undergraduate problem solving course. Findings from the first two years are summarized in the form of insights concerning teaching and learning genetics, implementing conceptual change in professors and students and the requirements for and value of collaborative endeavors between two faculties.

McClafferty, Terence P.

Strand 10 — Sun, 23 Apr, 1995, 7:00 PM, Exploratorium

Did you Hear the Message?: Visitors' Use and Understanding of a Sound Exhibit at Interactive Science Centers

Many exhibits at interactive science centres (ISC) are designed to demonstrate the principles of physics covered in school science syllabi. This paper investigates visitors' (n=180) use of an exhibit and their understanding of sound reflection. ISC have their own behavioural and instructional objectives for the *Whispering Dish* exhibit. Visitors to an ISC either ignore, or unsuccessfully engage or engage successfully with the exhibit. The issues explored in this study concern the visitors' comprehending of the exhibit, whether they get the exhibit to work, and their understanding of how the exhibit works. Visitor's comprehension could be categorised hierarchically into understandings about waves, waves and reflection, or waves, reflection and focusing. Process skills used by visitors during their interactions are identified.

McConney, Andrew A.

Strand 10 — Tue, 25 Apr, 1995, 2:30 PM, Suite 2601

The Effects of a Hands-on Environmental Science Program on the Attitudes and Career Interests of "Young Scholars"

Phillip B. Horton

This study reports the effects of two (1992 and 1993) hands-on summer programs on the environmental attitudes and science and engineering career interests of high-achieving secondary students. The programs were funded by NSF's Young Scholars Program and each year comprised an intensive, two week field study of east-central Florida ecosystems, followed by a two week field study of Great Smoky Mountains ecosystems. Field studies were hands-on and issues-based. They required small teams of students to generate hypotheses, collect and analyze data, reach conclusions and draw comparisons regarding habitat loss, human recreation impacts and possible sustainable-use solutions for both Florida and Smoky Mounts ecosystems. About 20 students from the south eastern US, selected based on application essays, grade point averages and extra-curricular activities, participated in each program. The study's results indicate more positive environmental attitudes for participating students, with males showing significantly more positive attitudes than their comparison counterparts. The results also indicate greater interest in science and engineering careers for participating students, although this effect was not significant at the five percent level. Last, little relationship was evident between environmental attitudes and science career interests—a surprising result that requires further investigation.

McDaniel, Patrice

Strand 6 — Sun, 23 Apr, 1995, 7:00 PM, Exploratorium

Critical Examination of Ethnicity, Class, Gender, Culture and Learning: Preservice Secondary Science Teachers

Denise Crockett Mary M. Atwater

This study investigates whether secondary preservice teachers' knowledge of ethnicity, class, gender, culture, or social class influence their beliefs about science learning and teaching and their interactions with diverse students in their classrooms. This study includes both a quantitative and qualitative component, utilizing the Teacher Student Instrument (TSI) and interviews of four students enrolled in a secondary science education program at a predominantly white university. The 25 students are predominantly white American, middle-classed females in their early to mid-twenties. The students all hold high school diplomas and currently hold an undergraduate grade point average of 2.0 or higher. The TSI developed by Margaret L. Ford (1979) will be administered on a pre- and post-test basis. Descriptive and inferential statistics will then be used to analyze the data. An open-ended interview will be conducted and audiotaped with approximately four preservice teachers in a science education program. Several questions will be designed to probe the preservice secondary teachers knowledge and beliefs related to their own cultural/ethnic/gender/class identification. This research is in its preliminary stages. All data will be collected during the fall and winter quarters of 1994-1995.

McElroy, Keith

Strand 4 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Bringing Summer Field-based Experiences Back Into K-12 Classrooms

This study provides insight into how a group of K-12 teachers, teaching in various cultural settings utilized experiences from a summer field-based environmental science education course in their K-12 classrooms. Fifteen teachers, teaching in either International Schools, Department of Defence Schools or United States Public Schools in countries such as, Japan, Columbia, Saudi Arabia, Malaysia, Germany, Africa and others, participated in 19 days of instruction, in nine field-based sites throughout Australia. The instruction focused on teaching for understanding and practical application in K-12 classrooms. Each participant developed and piloted a culturally sensitive unit plan that focused on understanding environmental concepts in their K-12 classroom. The findings provide insight, examples and reflections to K-12 practitioners teaching environmental science concepts in culturally diverse settings.

McGinn, Michelle K.

Strand 2 — Sat, 22 Apr, 1995 8:30 PM Emerald

The Transformation of Individual and Collective Knowledge in Elementary Science Classrooms that are Organized as Knowledge-building Communities

Wolff-Michael Roth

In recent years, the organization of elementary classroom as knowledge-building communities that reflect knowing and learning in everyday out-of-school settings has attracted increasing interest. The results presented here are based on extensive data including video-taped lessons, interviews and debriefings with teachers and observers. We describe in detail how students learned from each other such that both individual and collective knowledge were transformed. We use the notions of *apprenticeship, legitimate peripheral participation* and *embodiment* to conceptualize students' trajectories of competence from neophytes to experts. The study contributes to our understanding of the interaction of individual and collective knowledge.

McGinnis, Randy

Strand 4 — Sun, 23 Apr, 1995 4:00 PM Redwood

The Maryland Collaborative for Teacher Preparation Year One Report: Collaborating with Mathematics and Science College Professors to Construct Specialized Upper Elementary Middle School Teacher Preparation Programs

Anna Graeber, Genieve Knight, Gerry Rossi, Joan Langdon, Tad Watanabe, Marcia Cushall

The purpose of this year one study of a five-year longitudinal study was to investigate the preparation of specialized upper elementary/middle school mathematics and science teachers participating in a NSF funded Collaborate Project in Maryland. Participants included first-year prospective education students enrolled in specialized mathematics and science content courses and their content professors at six high education institutions in Maryland. This study reports: (1) the participants' beliefs and perceptions concerning mathematics and science content and its potential for integration and, (2) their perceptions of their specialized college content classes as exemplifying constructivist, technological and interdisciplinary instruction appropriate for diverse groups of upper elementary/middle school students. Implications for the development of the specialized teacher preparation programs are discussed.

McGlamery, Sheryl

Strand 4 — Mon, 24 Apr, 1995 4:00 PM California

Synergy: The Connection between Preservice and Inservice Teacher Education

James R. Holden

The focus of this research study was the interaction between inservice and preservice teachers as they jointly worked to improve the science instruction available to elementary aged children. Two school sites were involved in the study. Each site serviced more than 150 children in this science enrichment program. Each participating school site involved at least one main teacher participant, who interfaced directly with university science educators in order to plan and implement the project and study the results. Findings of the study show changes in both preservice and inservice teachers regarding: (1) reforms in classroom science instruction, (2) increased understanding of constructivist science instruction, (3) increased communication and sharing of ideas and issues, and (4) modifications in teachers' beliefs about teaching learning science.

McMahon, Maureen M.

Strand 7 — Mon, 24 Apr, 1995 4:00 PM Portola

The Effects of an Integrated Video-enhanced Chemistry Curriculum on Student Achievement and Attitudes in High School Chemistry

William S. Harwood

The purpose of this investigation was to view the achievement and attitude differences between high school students who experienced a general chemistry course enhanced with The World of Chemistry video series and control students who received no video-enhanced media interventions within their general chemistry course. Thirteen high school chemistry teachers and over 600 high school chemistry students participated in this year long experimental study. The standardised High School Subjects Test: Chemistry, individual researcher designed criterion referenced micro-unit tests and the High School Chemistry Student Opinion Survey were the tools employed to measure student achievement and attitude. Data showed that the students who experienced the video media intervention scored significantly higher than their peers who experienced no video treatment on all measures of achievement. Additional student and teacher interview and survey data offer rich responses explaining the personal attitudes and opinions of the treatment group participants regarding the integrated use of video media from both a science educator and science learner perspective.

McRobbie, Campbell J.

Strand 5 | Mon, 24 Apr, 1995 | 8:30 AM | Gold Rush B

The School Learning Environment: Place for Teacher Learning or a Busy Workplace

Kenneth Tobin

While considerable research has been carried out into strategies for initiating change in schools, many of these strategies have not resulted in sustained and continuing professional development. This study investigates the school learning environment from the perspective of an environment for continuing professional learning for teachers. It was an interpretive study informed by social constructivism. Six teachers in a science department were interviewed and surveyed on their experienced and preferred perspectives on the learning environment in the school as a learning place for teachers. The school was rated as more of a busy workplace than a place for teacher learning.

Mdletshe, Khumbulani D.

Strand 6 | Tue, 25 Apr, 1995 | 2:30 PM | Emerald

Attitudes and Expectations of Students and Teachers Toward Science and Science Teaching in South African High Schools

Jacob Manale | Paddy Lynch

The paper reports initial research into findings of student and teacher attitudes toward science and science teaching in South African high schools. A nine-school study was undertaken in three quite different socio-cultural contexts: three urban schools in the Eastern Cape; three semi-urban schools in the Gauteng; and three rural schools in Northern Transvaal. In each region, the schools also were selected on the basis of the extent to which they had access to Science Education Project (SEP) resources (i.e. experimental kits, written materials and training support). A comparison was made between full-SEP vs part-SEP vs non-SEP. The study investigated a number of important background variables and intervention effects. Data were collected from three sources by interview and questionnaire from nine principals and 45and 850 students in students Grades 6-10.

Melear, Claudia T.

Strand 6 | Sun, 23 Apr, 1995 | 8:30 AM | Suite 2601

Learning Styles of African American Children and NSTA Goals of Instruction

Beth Broadhurst

Atwater examined the need for science teachers to become multicultural (1989 & 1994). The NSTA policy statement on multiculturalism (1991) suggests that science teachers become familiar with learning styles which may be based on culture. African American heritage theorist Hale (formerly Hale-Benson) and others propose that many African American children do not do well in school due to a cultural conflict. This conflict is produced when American children with a culturally induced cognition from Africa come to schools designed primarily for white children and based on Western or Euro-American values and culture. Hale suggests that African American children have specific ways of learning that can inform teaching if educators know about them and will honor them in instruction. African American heritage theory embodies cultural difference theory described by Banks. Cultural difference theory proposes a different style of learning rather than a deficit and is closely aligned with all theories of individual differences. The styles presented are affective, person-centered (similar to field-sensitive), movement oriented and expressive. This paper described Hale's theories as presented in *Black Children: Their Roots, Culture and Learning Style* and analyzes those learning styles in terms of how NSTA goals of instruction (science for personal use, academic knowledge, societal issues and career exploration) can be met in classrooms. Two matrices will be presented to assist science educators.

Moje, Elizabeth B.

Strand 8 | Mon, 24 Apr, 1995 | 8:30 AM | Crystal

Building Dialogic Teaching and Research Communities in Science Education

William C. Kyle, Jr | Terry A. Scott | Mark J. Volkmann

This interactive session was designed to facilitate dialogue among science educators about the challenge of building dialogic communities. We examined and analyzed what Kagan (1993) refers to as a "gap" between what education reformers and researchers want teachers to do in classrooms and what teachers, students, parents and administrators want teachers to do in classrooms. Further, we discussed possibilities and processes for bridging this gap by building dialogical research and teaching communities in the field of science education. Specifically, we discussed how we would work toward understanding and valuing multiple perspectives, while continuing to work toward change in science education. We also examined possibilities for building bridges between members of the science education community instead of silencing the voices of teachers, students and parents.

Molina, Fernando

Strand 9 — Sun, 23 Apr, 1995 1:00 PM Washington

Supuestos Pedagogicos en el Uso del Lenguaje Logo

V. Vargas F. Daza

Desde inicios de 1989 la Secretaría de Educación del Distrito de Santafé de Bogotá introdujo el uso del computador en el aula de clase como un elemento de apoyo pedagógico. Al finalizar 1993 eran 42 los establecimientos oficales que usaban computador con una cobertura de 42.000 alumnos, aproximadamente. Se proyecta en un futuro lograr un cubrimiento de 6.000.000 de niños dotando a todas las escuelas de computadores. El presente trabajo identifica los supuestos pedagógicos del lenguaje LOGO que propicia un ambiente de aprendizaje enfocado en los procesos y no en los resultados. La metodología de resolución de probelmas propuesta constituye un modelo que permite desarrollar un lenguaje expresivo de los procesos de pensamiento. Se analizan los criterios pedagógicos que fundamentan este lenguaje y se confrontan con observaciones de sesiones de trabajo con LOGO en una escuela Distrital. Se encuentra que ante los probelmas y los errores nos hallamos frente a un maestro tradicional en sus actuaciones y distante de los métodos sugeridos en la propuesta. Se destaca el hecho de que el errores asimilado como fracaso desprovechando su potencial educativo. También se evidencia la necesidad de respuestas que tienen tanto el alumno como el profesor lo que conduce a que los problemas no sean convenientemente analizados como herramientas de aprendizaje. Por esto se sugiere un cambio en la actitud del maestro tendiente a manejar y comprender el error en forma diferente a fracaso y a ayudar al niño a construir sus propios modelos. Por lo tanto se recomienda un cambio de acción en la capacitación que se brinda a los maestros, que privilege el enforque pedagógico frente al técnico.

Moon, Barbara

Strand 4 — Tue, 25 Apr, 1995 2:30 PM Monterey

How Subject Matter Influences Beginning Teachers Perceptions of Teaching

Marvin Wideen Jolie Mayer-Smith

This study examined the beliefs about teaching and learning held by science and humanities preservice teachers. The six subjects were interviewed on successive occasions and observed during their student teaching. Field notes, transcribed interviews, questionnaires and reflective journals provided the sources of data. The study confirmed the existence of two cultures as posited by Snow and reexamined by Shuell. Both humanities and science students were in agreement as to what constituted "science" and "humanities". All saw science as a factually oriented subject external to them. All viewed the humanities as an area that provided outlets for personal interpretation and expression. The school and university experiences had been the primary factor in shaping such beliefs, particularly individual teachers. The perceptions held by these beginning teachers influenced their work in classrooms. The results of this study carry implications for teacher preparation. First, our results raise questions about the emphasis on generic processes because of the press of content when teaching. The results also show why many students are not attracted to the sciences. The prevailing view of a fact oriented discipline with little student voice leads many students to pursue other subjects.

Moore, Jacquelyn J.

Strand 4 — Sun, 23 Apr, 1995 4:00 PM Redwood

Contributors to the Decision of Elementary Education Majors to Choose Science as an Academic Concentration

Scott B. Watson

The purposes of this study were: (1) to determine the factors that influence the decision of elementary education majors to concentrate or not concentrate in science, and, (2) to determine the relationship between science locus of control orientation and age, cumulative grade point average and number of college science courses completed for the 69 elementary education majors involved in this study. Causal-comparative and correlational research methodologies were implemented for this study. All subjects were administered Haury's (1984) Locus of Control in Science scale to quantify science locus of control orientation. Results of this study related to the first purpose indicated no significant differences between elementary education majors concentrating in science and those not concentrating in science for science locus of control orientation, cumulative grade point average, or age. Results related to the second purpose indicated no significant relationships between science locus of control orientation and the following: age, cumulative grade point average, or number of science courses completed for the elementary education majors involved in the study. Further information gathered through the use of a questionnaire includes the following: the science concentration group reported more favorable experiences from kindergarten through college; their teachers were more knowledgeable and comfortable teaching science; and they received more encouragement in science.

Moore, Richard W.

Strand 10 — Mon, 24 Apr, 1995 8:30 AM California

The Scientific Attitude Inventory (SAI II): A Revision

R. Leigh Hill Foy

The *Scientific Attitude Inventory* (SAI), published in 1970, has been revised. The revision takes into account various criticisms and suggestions that have been made over the years. The new form is shorter, 40 items, it is easier to read and gender-biased language has been removed. The SAI II has been field tested with a group of Grade 6, 9 and 12 students (n = 557). Each of the subscales for the SAI II contributes positively to the total score for the instrument. A comparison of the highest and lowest 27% of respondents for the total test results in a significant difference between the two groups as indicated by a t test for independent samples at the .05 level of significance for the total score, for each of the six subscales, for the positive items and also for the negative items.

Morais, Ana M.

Strand 5 — Mon, 24 Apr, 1995, 2:30 PM, Monterey

Understanding Teachers' Evaluation Criteria: A Condition for Success in Science Classes

Clementina Miranda

The study is part of a broader research project whose main aim is to find out pedagogic practices which can improve students' science achievement namely in complex cognitive competencies. The study is based on Bernstein's theory. Previous studies have suggested that the explicitness of the criteria of evaluation is related to students' scientific understanding and achievement. One of the many ways in which the evaluation criteria can be made explicit to students is through assessment tests, their correction and marking. This study intends to analyse the extent to which students understand teachers' evaluation criteria, more specifically teachers' marking criteria and procedures, i.e. the extent to which they have recognition and realization rules to the assessing context. It also intends to analyse the relation of that understanding with social class, social context of the school, teacher's conceptual demand, teachers' explicitness of criteria and science achievement. The study showed a clear relation between students' acquisition of recognition and realization rules and social class — the higher the social class the higher that acquisition. A privileged school's social context and the teacher's explicitness of assessing criteria also contribute to students' understanding of teacher's evaluation criteria. This understanding influences science achievement, especially in complex competencies.

Moreira, Marco A.

Strand 9 — Sat, 22 Apr, 1995, 7:00 PM, Suite 2601

Kinds of Mental Representations - Models, Propositions and Images, Used by Physics Students and Physicists Regarding the Concept of Field

Ileana Greca

Our objective was to investigate at what level of mental representations students and physicists operate regarding the physical concept of field, particularly in the domain of electromagnetism, when solving problems and questions. Our theoretical basis lies in Johnson-Laird's theory of mental representations, according to which there are at least three major kinds of such representations: mental models, propositions and images. Physicists and physics graduate students were interviewed concerning how they use the concept of electromagnetic field when they do physics. Some 50 sophomore engineering students were observed during two semesters regarding the level of mental representations which they used when solving problems and questions proposed as instructional tasks. Research findings suggest that experts do use mental models, which basically could be propositional or rely mainly on images, or both. Students, however, work mostly with propositions not related or interpreted with respect to mental models.

Moscovici, Hedy

Strand 2 — Mon, 24 Apr, 1995, 2:30 PM, Washington

Fit and Misfit of Loci of Commitment and Their Impact on the Learning of Science in a College Biology Course for Prospective Elementary Teachers

The study explored the evolvement and dynamics of loci of commitment (or effort) of different participants in a college Biology course developed for prospective elementary teachers. The investigation followed mainly two instructors (from the total of six that were involved in teaching the course) and two students (chosen using SPSS cluster analysis on a Learning Environment survey and taking samples from the extremes). Both parts, instructors as well as students, were committed to the success of the course. Their commitment required the investment of time and equipment beyond the usual expectation. There were situations where students were interested to learn relevant science while the instructor was more committed to the content coverage, its richness and accuracy. Situations where there was a misfit between loci of commitment of students and instructor resulted in reciprocal discontent, lack of communication and from the students' part, low level of learning science. Results also indicated that loci of commitment were context dependent and the same instructor would change her locus of commitment according to diverse variables in a specific context.

Mulholland, Judith

Strand 4 — Mon, 24 Apr, 1995, 10:30 AM, Washington

Breaking the Cycle: Preparing Elementary Teachers to Teach Science

Judith Mulholland

This study employs a narrative methodology to give a holistic view of the experiences of five mature age preservice elementary teachers in a semester unit of science education. The unit was designed to help teachers examine and make explicit their ideas about science and science teaching and consider ways in which they might put those ideas into practice. The pivotal theme, around which the teachers' experiences could be organised, was found to be learning science. The preservice teachers expressed a need for a supportive learning environment in which concepts were built gradually and introduced using concrete examples. Previous science experience was found to be a major influence on the attitudes the participants brought to the present course. A lack of previous experience, or negative past experiences, were a major cause of anxiety. Gender was also important as it had limited the science experiences available to some participants in the past and continued to influence the way they participated in classes during the semester. Changing attitudes to science during the preservice experience is seen as an important step in breaking the cycle of the impoverished state of elementary science.

Murfin, Brian

Strand 4 — Sun, 23 Apr, 1995, 8:30 AM, Washington

A Survey of Telecommunications Use by Secondary School Science Teachers in New York City

The purpose of this study was to carry out a survey of telecommunications use in science in secondary schools in the borough of Queens in New York City. The information obtained was used to make recommendations on ways to encourage science teachers to learn to use telecommunications. Questionnaires were mailed to all secondary schools in the borough of Queens. Statistics were obtained on the types of computers used and preferred by science teachers, the use of modems and Internet techniques commonly used by teachers.

Naidoo, Sharadh

Strand 1 — Tue, 25 Apr, 1995, 8:30 AM, Oregon

Discovering Naive Intuitions in Heat Related Problems

Aletta Zietsman

Students contextualized reasoning as opposed to abstract mathematical reasoning receive little theoretical attention from researchers. We propose that we should not expect the best learning to occur in formal contexts of reasoning. To this end, the research reported here, investigated students' naive intuitions about heat as well as their spontaneous use of non-formal reasoning in their discussions of situations in thermal properties of matter. Case studies of interviews conducted will be presented. Preliminary results indicate that students have powerful naive intuitions about expansion and heat transfer phenomena, but that their justifications and explanations are often limited or non-existent. We have evidence of the use of extreme cases in reasoning about expansion phenomena. We are encouraged by these results, since little work has been reported on the roles that extreme cases might play in the learning of physics.

Nakhleh, Mary B.

Strand 1 — Mon, 24 Apr, 1995, 8:30 AM, Monterey

Elementary School Children's Theories of Matter

Ala Samarapungavan

The broad goal of this project is to study knowledge acquisition processes in science domains in elementary school children. The specific domain chosen to investigate these general issues is the nature of matter. We hypothesized that children are capable of forming spontaneous theories about matter and that these spontaneous theories may require radical, domain-specific restructuring in order to evolve toward an acceptable scientific understanding of the nature of matter. We further hypothesized that students' theories might range from the continuous to the particulate to the molecular level of understanding. We report our investigations of 1st, 3rd and 5th grade elementary school children's spontaneously constructed or "naive" theories about the nature of matter prior to any formal instruction in the domain. Fifteen students (7-10 years of age) were interviewed to ascertain their theories about the nature of matter. The interview was designed to probe students' theories of a set of phenomena on both the macroscopic and microscopic levels. We found that students' theories ranged from continuous theories (four students) to molecular theories (two students). Several students exhibited transitional theories. The implications of these findings for young children's theory-building will also be discussed.

Navarro, Estela

Strand 9 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

Kepler's Laws: An Example of the Integrated Teaching of Mathematics and Physics Using the Computer as a Tool

Araceli Reyes **Maria Trigueros**

English presentation of the topic below

Navarro, Estela

Strand 9 — Tue, 25 Apr, 1995, 1:00 PM, California

Las Leyes de Kepler: Un Ejemplo de Ensenanza Integrada de Matematicas y Fisica Utilizando la Computadora como Herramienta

Araceli Reyes **Maria Trigueros**

Normalmente la enseñanza en la escuela está muy compartamentalizada, se enseñande manera independiente los temas de matemáticas de los de física. Los resultados de la investigación reciente en la enseânza muestran que los estudiantes tienen dificultades para integrar los conocimientos. Con esta preocupación nos dimos a la tarea de buscar temas que se presten a integrar la enseñanza de ambas disciplinas. Se ha discutido mucho acerca del papel que juega la computadora en la enseñanza. Una de las posibilidades es usaria como mediador en la construcción de un conocimiento integrado, aprovechando la capacidad de la computadora para hacer simulaciones, para interactuar, para calcular y graficar. En este caso elegioms las leyes de Kepler por ser un ejemplo suficientemente rico y complejo, que so presta a ser abordado desde diferentes perspectivas. Tradicionalmente este tema no tiene relevancia en la enseñanza de la física en la secundaria.

Nelson, Barbara

Strand 4 — Sun, 23 Apr, 1995 4:00 PM Washington

Pedagogy Reforms in the Rocky Mountain Teacher Education Collaborative

Nancy Hartley

This paper describes the five year goals and the first year accomplishments in the reform of pedagogy courses and experiences targeted in the Rocky Mountain Teacher Education Collaborative. The pedagogical reforms center on the development of mathematics and science student cohort groups, the development of strategies for integration between pedagogy and mathematics and science courses, interdisciplinary team-taught courses and seminars and collaboration between schools and institutions of higher education. One of the most important aspects of this aspect of the reforms is the contribution made by mentor teachers, experienced science and mathematics teachers who collaborate with teacher preparation faculty in the redesign of the teacher education programs and help deliver on-campus coursework. This paper will describe the reforms initiated during the first year of the project and specifically describe their relationships to reforms in science and mathematics.

Nesbit, Catherine R.

Strand 4 — Sun, 23 Apr, 1995 2:45 PM California

A Comparison of Program Coordinators' Leadership Models in Science and Mathematics and Lead Teachers' Implementation of those Models in the Schools: Is there a Match?

Josephine Wallace **Anne-Courtney Miller**

The purpose of this study was to compare program co-ordinators' leadership models to participants' implementation of those models in schools. The 360 lead teachers from 180 elementary schools at eight university sites participated in a year-and-one-half professional development program to become lead science and/or mathematics teachers. Seven different leadership models emerged from data collected from program co-ordinators through interviews, observations and program documents. Data for the leadership models implemented in the schools were gathered through individual interviews at two randomly selected schools from each of the eight sites with lead teachers, their principals and other teachers about their perceptions of the leadership model used at their school. The implemented leadership models were analyzed to ascertain their adherence to the program co-ordinators' models. Results revealed that generally the lead teachers implemented the leadership role models that were designed by the program co-ordinators.

Niaz, Mansoor

Strand 1 — Sat, 22 Apr, 1995 7:00 PM Portola

A Lakatosian Conceptual Change Teaching Strategy Based on Student Ability to Build Models with Varying Degrees of Conceptual Understanding of Chemical Equilibrium

The purpose of this study is to construct a Lakatosian teaching strategy that can facilitate conceptual change in student (Ss) understanding of chemical equilibrium. It is based on the premise that cognitive conflicts must have been produced by the Ss themselves in trying to cope with different problem solving strategies. Results obtained show that the performance of the experimental group of Ss was generally much better than that of the control group. It is concluded that a conceptual change strategy must consider: core beliefs of the Ss, exploration of the relationship between core beliefs and alternative conceptions, Ss conceptions compete with the present scientific theories and at times recapitulate theories scientists held in the past.

Niaz, Mansoor

Strand 10 — Tue, 25 Apr, 1995 8:30 AM Crystal

Can We Integrate Qualitative and Quantitative Research in Science Education? Lest the Crevice May Become a Canyon

Wolff-Michael Roth **Michael Matthews** **Ken Tobin** **Ron Good**

Qualitative research in science education has highlighted the construction of knowledge by the students and its close relationship to their world views. This aspect of research had previously been neglected in science education. In spite of important contributions by both qualitative and quantitative researchers, there appears to be a widening gulf between the two groups. The main purpose of this Symposium is a critical appraisal of some of the fundamental underpinnings of qualitative and quantitative research, that could facilitate their integration.

Nichols, Sharon E.

Strand 4 — Mon, 24 Apr, 1995 4:00 PM Suite 2625

Perspectives on Teacher-learning and Science at an Elementary Professional Practice School

This study looks at the practices of science teaching in the context of a developing elementary Professional Practice School site and the dialectical nature of researching teachers' science teaching practices. Themes from the study highlight issues relevant to learning about teachers' science teaching practices and their learning in the context of developing our PPS site. At this school, science kits, science fairs and science carnivals were both encouraging and discouraging the teaching of science. In some cases, collaboration with teachers dialectically influenced reframing of our science perspectives encouraging the construction of new perspectives of science and overcoming personal experiences of disenfranchisement from science.

Nicolaos, Valanides

Strand 1 — Tue, 25 Apr, 1995, 1:00 PM, Portola

Formal Reasoning Abilities as Predictors of Academic Achievement

Scores on a standardized test of logical thinking of 523 Grades 10, 11 and 12 students attending the Science section in three schools showed significantly higher performance on probabilistic and combinatorial thinking items in favor of male students, whereas female students had significantly higher achievement than male students, when GPA, grades in Greek language, mathematics and chemistry, but not grades in physics, were considered. There were also age (Grade) related differences for control of variables, probabilistic and correlation reasoning items. Significant differences were also found between items related to the same reasoning mode. Control of variables, proportional, probabilistic, correlational and combinatorial reasoning had differential contribution to the prediction of academic achievement, but the proportion of variance attributable to them ranged from 0% to almost 20% depending on the subject matter, the gender, the school and the grade level of the students. Factor analysis of performance on each reasoning mode (two items from each reasoning mode) produced a one-factor solution, while factor analysis of performance on each item produced a three-factor solution. These results corroborate with the existence of specialized abilities dealing with specific domains of reality, rather than with Piagetian theory and signify the importance of individual difference variables.

Nieswandt, Martina

Strand 2 — Mon, 24 Apr, 1995, 8:30 AM, Suite 2625

Writing in Junior Chemistry Classes: An Instrument of Learning Science Meaningfully?

Our project can be interpreted as a contribution to support the development of scientific knowledge in junior classes. In this context we see writing as an instrument which leads to meaningful learning of chemical aspects and facts. Our writing project was carried out in four Grade 9 classes at the Gymnasium (secondary school) during the school year 1993/94. Four teaching units were covered in 30 lessons. We divided the classes into two groups, an experimental group and a control group. The experimental group received eight writing tasks as homework while the control group did the homework orally. At the end of every teaching unit all students took a test including tasks which required the reproduction and the reorganization of learned knowledge as well as the transformation of knowledge to new situations or problems. The test and the texts were analyzed under professional and linguistic aspects. We found that the significance of writing for the development of scientific knowledge became obvious.

Norman, Katherine

Strand 1 — Sun, 23 Apr, 1995, 2:45 PM, Nevada

Teaching Science in Inclusive Classrooms Through STS Investigations

Dana Caseau, Jennifer Cooper, Karen Valdivisco, Lisa Outlow, Greg Conner

During this session, the authors and four teachers from the San Juaquin Valley will present the results of a research study on the use of STS Investigations in regular education science classes that included students with learning and behavior al problems. The research was funded by a grant from CSU - Fresno and included; (1) classroom instruction for teachers on STS, (2) teacher-designed STS modules and, (3) piloting of the modules in K-12 classrooms. In addition teachers designed and implemented authentic assessments to evaluate student understanding of STS concepts. During this presentation, results of pre- and post-testing of teacher understanding and use of instructional methods will be presented, along with results of pre- and post-testing of K-12 students on Science, Technology and Society. Finally, the original hypothesis that "active investigations of STS issues will engage all students, including those with learning and behavior problems" will be addressed. Videotapes of activities related to the STS instruction in the K-12 classrooms were made and clips focusing on positive changes in behaviors will be shown.

Norman, Katherine

Strand 10 — Tue, 25 Apr, 1995, 2:30 PM, Emerald

Enhancing Networking at and Beyond NARST: An Overview of the NARST Committee for the Enhancement of Individual Networking

The purpose of this session is to present an overview of the NARST Committee for the Enhancement of Individual Networking and to stimulate discussion regarding needs and future priorities to be addressed by NARST and this committee. The committee is designed to specifically assist those who come to NARST meetings as the only representative from their colleges or universities and individuals who want additional means of networking with other science educators. This committee would organize functions and provide leadership for this group of individuals. The rationale and purpose of the committee will be discussed. Some of the issues to be presented emphasize the need for collaboration, communication and mutual support. Examples of these issues include: (1) the challenge for researchers at colleges and universities that focus on teaching rather than research, (2) the need for group support and collaborative planning with researchers outside the institution when an individual is the only science educator in a program or institution and, (3) special needs of science education researchers at community colleges.

Norman, Obed

Strand 3 — Sun, 23 Apr, 1995 4:00 PM Suite 2601

Multicultural Science Education: Philosophical and Historical Questions of Ownership

Multiculturalism forces reconsideration of some widely held notions about the image of science presented to students. The almost universally held notion that science is "Western" is one such notion needing re-examination. Presenting science as Western may have pedagogical implications in instructional settings involving diverse students. This paper re-examines the historical and philosophical bases of this claim and offers an alternative perspective in terms of which ownership of the scientific canon can be viewed. The dominant paradigm is currently the competitive one in terms of which unique features of European science are highlighted to buttress the claim that science is "western". By contrast, the inclusive paradigm advocated in this paper acknowledges the differences between the science of various cultures but focuses on the overwhelming extent to which modern science has drawn from the contribution of these different cultures. On the basis of this cross-fertilisation science cannot be designated as the exclusive cultural property of any one group. An inclusive perspective challenges science educators to uncover and highlight the various historical junctures at which different cultures contributed to the mainstream of science.

Norris, Stephen P.

Strand 8 — Tue, 25 Apr, 1995 2:30 PM Emerald

An Attainable Version of Intellectual Independence for Nonscientists

This paper draws upon a recent philosophy of science that implies that the goal of intellectual independence, as traditionally conceived in science education, is unattainable. It is shown how intellectual independence is motivated by a justified true-belief definition of knowledge. This conception has been criticized on the grounds that for much of what we know about science it is in principle not possible for us to obtain justification. This conclusion applies to much of the scientific knowledge that scientists themselves hold. However, what individuals claim to know matters to them and to others. Thus, science educators must be concerned with the legitimate and attainable roles individuals can play in their knowledge acquisition. To articulate this role an attainable version of intellectual independence is advanced. It avoids the dilemmas inherent in the standard conception of the goal, yet provides individuals with the power to distance themselves from science, not so they can assess the truth of scientific claims to knowledge, but rather so they can assess the justifications for proposed applications of that knowledge.

Novak, Joseph D.

Strand 5 — Sun, 23 Apr, 1995 2:45 PM Monterey

The Use of Metacognitive Tools to Facilitate Knowledge Production

Richard Iuli

Metacognitive tools have been used extensively to facilitate student acquisition of knowledge. The application of metacognitive tools to facilitate research productivity, however, is a new area of exploration and, so far as we know, no other work has been done using constructivist learning tools such as concept mapping and Vee diagramming to facilitate research productivity. The study will report on research done with a team of researchers studying ultrasonic, aeroponic root growth and related problems. The data involved analysis of concept maps and Vee diagrams prepared by researchers and extensive clinical interviews with researchers on ways in which the tools have worked for them, including specific examples of facilitation of their work. The tools have also been applied in a corporate setting for new product development with a Fortune 100 company. Examples of the ways in which the tools have been developed and qualitative feedback derived from participants will be presented. Finally, the range of applications of these metacognitive tools for research facilitation will be discussed and feedback from the audience sought.

O'Rafferty, Maureen H.

Strand 1 — Mon, 24 Apr, 1995 4:00 PM Nevada

Difficulties with Density: The Performance of Grade 9 Students in the USA on a Density Task

This was a secondary analysis of data collected as part of the Second International Science Study (SISS) organized by the International Association for the Evaluation of Educational Achievement (IEA). Responses of a sample of 322 Grade 9 students from 39 schools to a density task were analyzed. A spring scale and a graduated cylinder were to be used to find the mass and volume of a lead sinker and the density of the sinker calculated using the formula: density = mass/volume. Successful performance of the task did not require an analytical conception of density; students did not have to recall appropriate units for mass and density since these were marked on the measuring instruments they used; and the formula was provided. Only 8% of students gave answers for density of acceptable magnitude and with units correctly specified. Many very idiosyncratic ideas and procedures were invoked. This study indicates the extent to which both the ideas taught in school science and acceptable in Grade 9 science classes and alternative responses were employed in responding to the density task.

O'Sullivan, Kathleen A.

Strand 5 — Sat, 22 Apr, 1995 8:30 PM Emerald

Evaluations in the Life in the Universe Curriculum Development Project

The Life in the Universe Curriculum Project developed six teacher guides based on topics related to the study of the existence of life in the universe and the search for extraterrestrial intelligence. Intended characteristics of guide lessons included; high student involvement, interdisciplinary and up-to-date content and appeal to teachers and students. Integral to the development process was the collection of feedback on draft materials from over 120 field test teachers, their students and 30 scientists. Closed and open formats for written responses to individual lessons and comprehensive telephone interviews were used to collect feedback from teachers. A letter with focusing questions was used to prompt letters from students; in addition, achievement tests, using a pre/post control group design, were administered to small numbers of students. Scientists reviewed individual lessons via direct commentary and responses to closed questions. Both raw data and first reductions of them were used in revisions of the curriculum materials; highly reduced data were analyzed for summative purposes. Overall responses from the three groups indicated that the objectives for the materials were achieved. Recommendations for curriculum development evaluations based on the strengths and limitations of these evaluations, are presented.

Odom, Louis

Strand 4 — Mon, 24 Apr, 1995 10:30 AM Washington

The Development and Application of a Diagnostic Test to Assess Teachers' Understanding of the Learning Cycle

John Settlage, Jr

The purpose of this study was to investigate science teachers' understanding of the learning cycle. This study describes the development of a diagnostic test designed to assess teachers' understanding of the learning cycle and highlights common misconceptions identified through the administration of the instrument. The test items are two-tiered with the first tier in a multiple choice format with two, three, or four choices. In the second tier students explain the reason for their multiple choice selection. Free response reasons were analyzed for level of student understanding using a rubric designed specifically for the learning cycle diagnostic test. The test was administered to 65 teachers enrolled in a science teaching methods course in which they received instruction on the learning cycle prior to testing. Teachers had a wide variety of conceptions about the learning cycle. Numerous misconceptions are noted and implication for teaching the learning cycle to teachers are discussed.

Odom, Louis

Strand 1 — Sun, 23 Apr, 1995 4:00 PM Monterey

The Relationship between High School Biology Students' Content Knowledge of Diffusion and Osmosis and their Confidence in their Content Knowledge

Lloyd H. Barrow

The purpose of this study was to investigate conceptual change toward scientifically acceptable conceptions by assessing the relationship between an individual's content knowledge of diffusion and osmosis and their confidence in their content knowledge following instruction The Diffusion and Osmosis Diagnostic Test (DODT) was used to assess concept knowledge. In addition, the students were asked to determine confidence in their selection for each tier of the test with the following statement: I am _____ sure about my answer - 100% 80% 60% 40% 20% 0%. A student was assessed to be confident in their answer when they selected 80% or above on each tier and not confident when they selected 40% or below on each tier. Conceptual change toward scientifically acceptable diffusion and osmosis conceptions did not occur for the large majority of students in the study. This study reaffirms the tenacity of alternative conceptions and helps to validate the need for teachers to use non-traditional teaching methods to teach science content. Implications are discussed.

Odubunmi, Emmanuel O.

Strand 6 — Tue, 25 Apr, 1995 1:00 PM Emerald

Students' World View Relative to their Level of Science Learning and Socio-economic Background

The study tried to determine whether the level of science learning and socio-economic background of the students can affect their world view. This study therefore, involved 382 students from JS3 (186) and SS3 (196) classes - grades nine and twelve. In order to determine students' world view, the author designed an instrument with two sections. One section consists of variables to measure socio-economic background of students while the other section consists of 17-item Likert scale type to determine the world view of students on reproduction in humans. After it has been ascertained that students at the two levels of science learning had been exposed to learning experiences on the topic, the instrument was administered. Results indicated that most SS3 students strongly disagreed with thirteen of the statements agreed to by most JS3 students. It was also revealed that more respondents from the low social group strongly agreed with most of the statements especially at the JS3 level. It has, however, been found that some of the statements on evil forces and one claiming God as all powerful have attained stability level.

Ogbu, John

Strand 6 — Sun, 23 Apr, 1995 2:45 PM Emerald

Minorities and the Teaching and Learning of Science

This study describes different types of minorities in contemporary urban industrial societies. Explanations will be given to interpret why these minorities differ in their interpretations of cultural and language differences and the implications of such differences in teaching and learning science.

Oka, Evelyn

Strand 2 — Mon, 24 Apr, 1995 2:30 PM Redwood

Scientific Reasoning as Appropriate and Adaptive to the Surrounding Context

E. David Wong

Recognizing the contextualized nature of scientific reasoning leads to two important conclusions: it may be difficult or impossible for students to always reason and act as scientists do, and the criteria for what is considered appropriate and effective reasoning may also depend on the specifics of the context. How, then, might we determine whether reasoning is appropriate or scientific? In this paper, I am proposing that reasoning and activity is appropriate to the degree that it adapts in four context-constraints and evaluation criteria. These four dimensions were selected because they are hypothesized to be influenced by the surrounding context and they help to describe, distinguish and analyze scientific reasoning across individuals and settings. To determine the model's value as an analytical tool, it was applied to three different hypothetical cases of scientific reasoning. In each case, a comparison was made between how scientists in scientific settings and individuals in non-scientific settings might reason about a given problem (designing a warm outfit for winter, finding and observing birds, understanding how infants develop their personality).

Okebukola, Peter

Strand 1 — Sun, 23 Apr, 1995 4:00 PM Suite 2625

Concept Mapping as a Tool for Problem Solving in Science

Olu Jegede Rose Agholor

An area of prime importance in Science teaching is that of problem solving. This study examined the impact of concept mapping experiences in individualistic and cooperative-learning settings on problem solving abilities of students. Three groups of pre-degree biology students who are involved in an on-going study on concept mapping in the Lagos State University, Nigeria, served as subjects. Data collection on the problem solving performance of the 60 subjects took the form of written and audio-taped records of think-aloud transaction as the subjects tackled the problems in the Biology Problem Solving Test. Data obtained provide supportive evidence that the subjects who were adjudged to be good concept mappers exhibited superior performance in solving the three problems of the study. Problem solving is a complex process involving problem recognition, defining the problem, generating possible strategies to solve the problem, implementing a strategy and evaluating to see if the problem has been successfully resolved. The overall process, therefore, involves the integration of conceptual knowledge and strategic knowledge to which concept mapping would appear to be a potent tool.

Olsen, Timothy P.

Strand 7 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Enabling Student Research of Environmental Problems Using a Geographic Information Systems Approach

This poster paper will describe the actions taken, negotiations made and environments evolved to enable high school students to research and proposed solutions for local environmental problems using a geographic information system (GIS) approach. GIS is defined as "a system of hardware, software, data, people, organisations and institutional arrangements for collecting, storing, analysing and disseminating information about areas of the earth". As personal computer platforms have become cheaper and more powerful and software has rapidly gained new functionalities, it has become increasingly possible for high school students to make use of computers as scientific instruments in the same ways that scientists do. The report provides a snapshot of an ongoing curricular experiment. The experiment provides information on how a teacher and an educational researcher cooperated to provide tools, resources and information to help students carry out scientific research.

Orion, Nir

Strand 4 — Tue, 25 Apr, 1995 2:30 PM Monterey

Changes in Perceptions and Attitudes of Preservice Postgraduate Secondary Science Teachers' Students

David Thompson

This study deals with perceptual and attitudinal changes of British preservice secondary Science teachers. The following aspects were addressed; views about education through science; views about aims and goals of science education, classroom management, teaching schemes and instructional strategies; self-concepts as a science teachers; self-confidence and expectations of PGCE (Post-Graduate Certificate of Education) program. The research was conducted amongst 38 students. It combined qualitative and quantitative methods and emphasised the following characteristics: (1) The progressive ideas which they already possessed and their considerable motivation in entering the program, (2) the idiosyncratic nature of the student teachers throughout the teaching practice, (almost all the students passed through a dynamic process of transformation and change of perceptions and attitudes about science education in schools), and (3) their narrowly practical view points and learning abilities. The influence of the university tutors was effective only whilst the students found that their ideas provided them with useful and practical teaching tools. The students could only dimly understand the relevance of many theoretical and philosophical ideas presented by their tutors. It is suggested that these findings might serve as good starters for developing a more effective preservice education and training program.

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Orpwood, Graham

Strand 5 — Sun, 23 Apr, 1995 8:30 AM Suite 2625

How Would You Know If Your Science Education Reform is a Success? Developing Science Indicators at the School District Level

Erminia Pedretti

This research comprised the adaptation of the Rand Model for Educational Indicators for use at the school district level, development of a system of indicators and the collection of baseline data from which school and district administrators can determine the degree and nature of the effects of a reform initiative. Twenty important aspects of science and technology education were measured and the data analyzed to provide initial conclusions for the district and to enable evaluation and refinement of the indicators themselves. For example, the indicators show that only one-third of all elementary school teachers teach science and technology for more than three hours per week, that while all teachers endorse a "hands-on" approach to teaching science, only half of them actually use such an approach and that while the district rhetoric continues to emphasise the strategic renewal initiative, overall budgets have in fact been cut over the past two years.

Orquiza de Carvalho, Lizete M.

Strand 1 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

The Process of Conceptual Change about Collisions

Alberto Villani

Recent researches about alternative conceptions and conceptual changes have faced the problem of characterizing the evolution of the students' knowledge. There is a hope of recognizing the specific or general mechanism that regulates this process of evolution. On this perspective we conducted qualitative research with six secondary course students, using the series of seven or eight individual interviews. During the interviews the interviewer alternately showed to the students simple experiments about collisions, asked them previsions and explanations about the results, discussed their answers and gave suggestions. Sometimes she asked them to make questions. The more interesting results of the research have been the characterization of the students' mental representation evolution as processed in two stages (concerning phenomenological and formal representations), in which the students accomplished the conquest of some common objectives. Such process revealed itself as strongly dependent on the analyzed situation. We can synthesize our conclusions in the idea that there is a straightened correlation between the collision phenomenology and the conservation principles dominions. In this particular way, we detected that it is necessary to promote the occurrence of determined conquest in a special situation, in which the conflict between spontaneous ideas and the new notion should be specially sharp.

Ostrander, Ray

Strand 4 — Tue, 25 Apr, 1995 2:30 PM Oregon

An Examination of Gender Equity Attitudes at a Conservative Protestant University

Gender equity has been a growing concern in many higher education institutions. Today it is not uncommon to find college and university courses designated to gender studies as well as special gender equity interest group presentations at most educational professional meetings. However, I would posit that there are many smaller church-related institutions that have little if any gender equity awareness and consequently do not implement policy that reflects this awareness. As an associate professor in one such university, it is my purpose to explore existing attitudes toward gender equity issues within my university, run by a conservative Protestant constituency. This examination will be operationalised through the analysis of a Likert survey of randomly selected classes across the curriculum, anecdotal gleanings and an examination of stated policies versus practices coupled with demographic profiles of students, faculty and staff as well as explanations of the institution's culture and history.

Ottevanger, Wout

Strand 5 — Tue, 25 Apr, 1995 8:30 AM Redwood

Curriculum Reform in Namibia

Jan van den Akker

The INSTANT Project assists teachers in Namibia with the introduction of a new learner-centred curriculum for the subjects mathematics and science. It has adopted a developmental research approach which is characterised by the selection of a number of exemplary themes, the provision of procedural specifications in order to facilitate initial implementation of curriculum changes in the classroom, standardised design of the modules applying basic principles on materials and text design as well as systematic formative evaluation of the modules. This study includes the cyclic design and formative evaluation of a teacher guide on the topic of Scientific Processes. The formative evaluation took place in schools in two different educational regions. Instruments for data collection included classroom observations, teacher logbooks and interviews as well as learner questionnaires and interviews. The results of the study include better materials and a better understanding by the teachers of how to translate the curriculum in specific classroom activities as well as suggestions for activities for future in-service workshops. Moreover, the approach of co-operative evaluation with teachers has boosted the co-operation between them and their schools, which is seen as important in building an infrastructure for in-service in the regions.

BEST COPY AVAILABLE

Pacca, Jesuina L.

Strand 9 — Mon, 24 Apr, 1995 10:30 AM Monterey

Maestros Actualizando Otros Maestros: Estudio de Caso/Teachers Updating Other Teachers: A Case Study

Alberto Villani M. Cristina Mariani

Secondary school teachers attending an inservice course had the opportunity to re-elaborate their conceptions on teaching and to modify their practices. Four of these teachers were invited to give a similar updating course to another group of their colleague teachers. This experiment enabled us to study the problem of forming multipliers who could lead other professionals to a conceptual change regarding the teaching of physics, with consequences on their real daily practice. Both courses lasted 150 hours; the content dealt with Newton's laws. The procedure adopted required teachers to elaborate pedagogical planning which then was applied to their students and which, after an analysis of results, was re-elaborated. A similar procedure, assisted by the program authors, was followed by the four multiplier teachers in relation to pedagogical planning for the updating course. As a result, we could point out some of the factors which seem to contribute to the formation of a multiplier: (1) the necessity of evaluating the plans which have been prepared by teachers; (2) the difficulty in convincing teachers to leave their common-sense conception; (3) the lack of clear and broad objectives for every meeting; and (4) the lack of explicit procedures to lead discussions.

Pachón, Ernesto

Strand 9 — Sun, 23 Apr, 1995 2:45 PM Suite 2625

La Ensenanza y el Aprendizaje de la Bioquimica Desde la Perspectiva de la Teoria General de Sistemas

La Bioquímica como ciencia presenta los rasgos fundamentales de un sistema puesto que posee un ilmite que define las fronteras que separan el sistema del mundo exterior, unos elementos que pueden ser enumerados y categorizados, y un sistema de comunicaciones que permite el intercambio de materia, energía o información entre los diferentes compartimentos eclulares. Coneste enfoque, la transducción de energía en los seres vivos trata de explicarse y comprenderse, desde la perspectiva de la teoría general de sistemas. Toda la fenomenoiogía bioquímica, puede considerarse como un sistema que se designará Sistema Transductor de Energia, sistema abierto y con recursivdad evidente. El (STE) se puede considerar como formado por varios subsistemas: el Subsistema Molecular (SSM), el Subsistema Translocador (SST), el Subsistema Catalítico (SSC), el Subsistema Procesador (SSP), el Subsistema de Soporte (SSS) y el Subsistema de Regulación (SSR), El STE, en términos generales, comprende aquellos processos mediante los cuales los organismos vivos utilizan los materiales que les sirven de alimento y en una forma autónoma y regulada los transforman en productos de desecho con aprovechamiento de la energía contenida en aquellos, para realizar las funciones biológicas propias de cada tipo de organismo. Tipicamente describe la forma en que la célula transduce la energía proveniente de una fuente primaria o secundaria de energía en otras formas de energía utilizables por la célula.

Palmeri, Amy B.

Strand 3 — Mon, 24 Apr, 1995 10:30 AM Suite 2601

The Consistency between Second Grade Teachers' Attitudes and Beliefs toward Teaching Science and their Science Teaching Practice

This collective case study focuses on the description and analysis of second-grade teachers' attitudes toward and beliefs about teaching science and their science teaching practices. Data for the study come from five interviews, six classroom observations, two questionnaires and an analysis of documents used by each teacher. Purposeful sampling was utilized to select four "experienced" second-grade science teachers. Data analysis, of individual teachers and comparative analysis across teachers, suggests that teachers struggle with creating a balance between the processes and content of science and describing the place of science in the overall curriculum. In addition, teachers seem unaware of the consistency or lack of consistency between attitudes and beliefs about teaching science and their science teaching and how consistency could improve their teaching.

Pankiewicz, Philip R.

Strand 4 — Sun, 23 Apr, 1995 2:45 PM Washington

Teachers' Attitudes Toward Science Education Research: A Classroom Survey

Obed Norman

Science education research is experiencing a crisis because some educators feel that the research is irrelevant with little to offer policy makers, curriculum developers and especially classroom teachers. Is this perception correct? The purpose of this study was to determine the attitudes and perceptions of science teachers toward science education research. To accomplish this, a questionnaire was developed and mailed to teachers in three different states (GA, WA and NY). Preliminary results show that although there was agreement that science education research should be conducted as a joint enterprise of classroom-based teachers and university-based researchers, respondents were not overly eager to get involved in classroom research projects, citing their busy schedules.

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Pankratius, William J.

Strand 4 — Tue, 25 Apr, 1995 1:00 PM Washington

Misconceptions Held by New Science Teachers

A 50 item survey of "alternative conceptions" of scientific terms, concepts and principles was administered to forty-two elementary and twenty-seven secondary science methods students. Sample items included: (1) The metric system is more accurate than other measurement systems, (2) expansion of matter is due to the expansion of particles, and (3) acquired characteristics can be inherited. The survey included a free response question asking the students to describe how the kinetic theory explains heat transfer. Results are highlighted by findings pertaining to one group of prospective secondary science teachers: (1) one out of three believe that the metric system is more accurate than other measurement systems, (2) forty percent feel that machines "put out more energy than is put in", and (3) two out of three believe that the expansion of matter is due to the expansion of particles—the same number cannot adequately explain the kinetic theory of matter. On the positive side, only three elementary teachers-to-be believed that astrology is able to predict the future, that there is a separate up and down in space and that an object at rest has no energy.

Pardo, Luz B.

Strand 9 — Sun, 23 Apr, 1995 2:45 PM Suite 2625

Un Modelo Para la Ensenanza y el Aprendizaje de la Bioquimica Basado en la Formacion y Adquisicion de Conceptos

Emesto Pachón

Se presenta un modelo para la enseñanza de la Bioquímica, basado en la formación y adquisición de conceptos. Los conceptos fundementales se pueden agrupar en las siguientes categorías: naturaleza de las biomoléculas, modelos de reacción bioquímica, objetivos metabólicos, economía celular, rutas de procesamiento y mecanismos biocibernéticos. Las tareas instruccionales diseñadas en forma de taileres, tienen como característica fundamental el empleo de ejemplos y no-ejemplos a partir de los cuales se construyen reglas de generalización y se forman o adquieren conceptos. El término adquisición hace relacíon a una estrategia empleada cuando el estudiante posee una cierta idea o noción relacionada con el concepto. El modelo instruccional para la formación de conceptos se emplea cuando el concepto es nuevo para el estudiante y esta destinado a ayudar al estudiante a diferenciar las propiendades de los eventos u objetos, a agrupar estas propiedades basades en elementos comunes y a formar sus propias categorías. La sintaxis del modelo incluye cuatro fases: 1. Presentación de metas y establecimiento del escenario. 2. Definición, señalamiento de los atributos y confección de listas. 3. Presentación de ejemplos y no-ejemplos. 4. Anááisis del pensamiento e integración del conocimiento.

Park, Sung Hye

Strand 4 — Sun, 23 Apr, 1995 8:30 AM Emerald

Preparing Elementary Science Teachers in Korea

Tom Dana

The primary purpose of this descriptive study was to collect detailed information about the nature of elementary science teacher preparation experiences at a teachers' college in Korea. The two theoretical perspectives of ethnography and phenomenology were embodied in this study. Consistent with those perspectives, the methods employed in this investigation were interpretive, involving transcripts of semi-structured interviews with future teachers, field notes of observations of prospective teachers' everyday activities at the university and documents from science education courses. Analysis of the data five major themes: (1) the national curriculum for the elementary school guides teacher preparation, (2) science education courses are differentiated amoung junior and seniors, (3) advanced courses in science education include themes such as STS and the national curriculum for the elementary school guides teacher preparation, (4) there is a strong emphasis on mathematical concepts and, (5) field experience is perceived as learning the "right way" to teach. This descriptive study of elementary teacher preparation in science in Korea shows that the centralized national curriculum has great influence in shaping the educational practices at the teachers' college.

Parke, Helen

Strand 5 — Sun, 23 Apr, 1995 4:00 PM Oregon

After Three Years in a Middle School Reform Project: Are Students Scientists Yet? Involving Teachers in Designing Assessments to Align with Reform Goals

Wendy McColskey — James Altschuld — Rita O'Sullivan — Randy Yerrick

During the 1993-94 school year, data were collected from North Carolina middle school science teachers participating in a national reform project. This research focused on the development of alternative assessments that would align the reform goals. East Carolina University collaborated with SERVE and NCSTL in observing teachers' changing perceptions of alternative assessment. Focus group interviews examined assessment strategies used by teachers and the effects of alternative assessments on student-teachers interactions. The teachers also engaged in conversations about the process of assigning grades. Teachers used portfolios in their classrooms and designed unit assessment packages that represented a comprehensive approach to important unit outcomes. This seminar will discuss the process of involving teachers in the design of alternate assessment as well as the advantages, disadvantages and barriers to alternate assessment. Also presented will be the data collected from interviews of teachers, guidance counselors and principals at four schools.

Parker, Dawn

Strand 3 — Tue, 25 Apr, 1995, 8:30 AM, Gold Rush A

TARPS I: Demonstration of the Teachers As Research Partners (TARPS) Model

Robert Borjes Andrea Foster

This first paper in a set of five demonstrates the Teachers As Research Partners (TARPS) model for reflective practice that supports teacher decision making. The TARPS model is introduced to the audience by three middle school teachers who are part of the Teachers As Research Partners National Science Foundation Teacher Enhancement Project. Teachers represent mathematics, science and health science content areas in middle schools of differing sizes from both rural and urban communities. The teachers demonstrate the model by solving an interdisciplinary instructional planning task that integrates mathematics and science. They present an overview of the knowledge and experience base of the population of students for whom they are planning the lesson and then think aloud as interdisciplinary middle school team members, demonstrating their curricular decision making using the TARPS model. The hypercard software that supports and represents the teachers' cognitive processing is displayed as they collaboratively plan a lesson. A lesson profile is generated that allows teachers to evaluate the probable effectiveness of the lesson.

Parker, Lesley H.

Strand 6 — Sun, 23 Apr, 1995, 4:00 PM, Gold Rush B

Theory Revisited: Further Exploration of a Model of the Relationship between Gender and Science

Léonie Rennie Jane Butler Kahle Dana Riley

At a Plenary Session at the 1993 NARST Annual Meeting, Kahle, Parker and Rennie presented a model for conceptualizing gender differences in science education (Kahle, Parker, Rennie and Riley, 1993). The objectives of the "Novel Format Interactive Session" proposed here are to explore further the model presented at NARST '93, to initiate further testing of the model by other researchers, to stimulate further research on this topic and to provide participants with the opportunity to experience and critically evaluate an innovative learning format. The Session will begin with a short description of preliminary work with researchers and teachers, which has resulted in an elaboration of the model from the perspectives of both research and practice. Participants will then be invited to explore further the potential of the NARST '93 model, using a modification of the Jigsaw strategy developed during the preliminary work.

Parker, Lesley H.

Strand 6 — Sun, 23 Apr, 1995, 8:30 AM, Suite 2601

Different Modes of Assessment in Science and Mathematics: A Systematic Interaction with Gender

Joanne E. Tims

The research reported in this paper focused on assessment procedures conducted in science and mathematics subjects, at the end of the final year of high school in one Australian State. The objective of the analysis reported here was to establish whether different modes of assessment produced any systematic effect on students' measured levels of achievement in science and mathematics. Students' scores in five Grade 12 science subjects and three Grade 12 mathematics subjects, for the seven years 1987-1993, were analysed. The analysis revealed that, consistently, across all science and mathematics subjects and all years, males appeared to have an advantage on external examinations, while females had an advantage on school-based, teacher determined assessment. The paper discusses the implications of this finding for researchers and practitioners committed to fair and equitable assessment.

Parker, Lesley H.

Strand 10 — Sun, 23 Apr, 1995, 10:30 AM, Emerald

Gender Issues

Léonie J. Rennie

A review is provided of research findings which describe, and attempt to explain, the different patterns of participation of males and females in science. Also, a description is given of strategies implemented in various parts of the world that address the problematic relationships between gender and science. Finally, a summary is provided of the messages from research and evaluation, and the contributions of strategies that hold most promise for effectiveness and efficiency in future policy and practice are identified.

Parsons, Sharon

Strand 4 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

Establishing an Action Research Agenda for Preservice and Inservice Elementary Teacher Collaboration on Self-empowerment in Science

Karen Reynolds

This paper reports on the initial phase of an action research project involving preservice and inservice elementary teachers who are attempting to bring a science emphasis to their teaching. The project objectives are to: (1) establish elementary science emphasis sites, a variation of the Holmes Group (1990) concept of a professional practice school, (2) develop an emancipatory action research climate (Carr & Kemmis, 1986) which is theory generating rather than theory driven, and (3) utilize current research in fostering self-empowerment of elementary teachers in science. In addition, and central to the project's success, is on-going collaboration between the university teacher preparation program and school sites.

Peasley, Kathleen L.

Strand 2 — Mon, 24 Apr, 1995 10:30 AM Nevada

Using New Discourse Patterns to Support Learning in Science Class: The Case of Derek

This study is an analysis of one third grade student's science learning and his participation in the science discourse in a classroom in which the teacher was attempting to establish new discourse norms. These norms were designed to support students in socially constructing their understanding of the science content and were an explicit part of the science curriculum in this racially and ethnically diverse classroom of 42 students. Analysis of the target student's pre- and post-unit tests and interviews revealed a change in his conceptual understanding of the topic of temperature measurement and changes. Qualitative methods of analysis were used to analyze transcripts of small and whole group discussions in order to determine if there were identifiable aspects of the participation structure which may have supported this student in developing his scientific conceptions. Additionally, concept maps were used to trace the flow of ideas both through individual discussions and in discussions across time. These maps graphically illustrate how one teacher is able to use the classroom discourse to help students move from a naive conception to a scientific conception.

Peiffer, Bernadette M.

Strand 10 — Sun, 23 Apr, 1995 8:30 AM California

Interactive Science Exhibits on Color Concepts: Testing an Educational Design Model

Edward Lucy

The purpose of this study was to develop and test an educational design model for interactive science exhibits based upon a constructivist approach to learning and an intrinsic motivation exhibit design model proposed by Perry (1989). A secondary goal was to characterize mental models of color phenomena among middle schoolage children and their parents who visit an interactive science center. Data on time and quality of visitor's interaction with, as well as evaluation of exhibits, were gathered for exhibit versions before and after redesign using the model developed for the study. Visitor interviews discussing explanations and predictions of color phenomena presented at exhibits were also compared for the original and revised versions of exhibits. Results indicated that visitors spent more time reading, manipulating and discussing the new versions of the exhibits than the original versions. Analysis of interviews uncovered differences in explanations of and predictions about color phenomena among visitors using the new exhibit version over the original.

Pesa, Marta

Strand 9 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Do Teachers "Help" Students to Strengthen Preconcepts? Some Reflections about the Teaching of Image Formation by Converging Lenses

Leonor Colombo de Cudmaßilvia Bravo

A series of instructional situations related to image formation by converging lenses — which show the way in which teachers unwittingly may help to strengthen students' prescientific structural schemata — were are analysed. Very often, teachers used simplified sketches, stereotyped diagrams, or somewhat inaccurate language which, even though in general not considered wrong to a certain extent, were coherent with the intuitive paradigm. The process of conceptual change in physics from a constructivistic point of view requires the adoption of methodologies tending to make the restructuring of alternative conceptions easier. Therefore, as part of this process, teachers should adopt a critical and thoughtful attitude toward their own misconceptions, as related both to the structure of the physics and their students' intuitive ideas.

Petrosino, Anthony J.

Strand 1 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

The Bernoulli Effect: Initial Study of Open and Closed Systems

Daniel L. Schwartz

The purpose of this study was to understand and seek ways to develop middle school students intuitive understanding of the distinction between an open and closed system. This is a general and deep distinction that runs through numerous branches of science. Participants in the initial study consisted of twelve (seven male and five female) middle school students from an urban public grammar school. The cohort represented a wide distribution on standardized achievement tests as well as classroom grades for the 1993-94 academic school year. A number of data sources, both quantitative and qualitative, yielded information concerning the subjects' perceptions and explanatory rationale for the phenomena under investigation. Results indicate that students have difficulty in assessing pictorial representations of water flow in closed systems. While we briefly explored this phenomena with the Bernoulli effect, such findings may have application in other contexts such as the study of entrophy, the conservation of energy, or the study of complex biological ecosystems.

Phillips, Denis

Strand 10 — Sat, 22 Apr, 1995 4:00 PM

The Many Faces of Constructivism

Constructivism is currently of great influence in the field of science education, but there is some confusion about what constitutes the core of this general position. In education, the dominant form is perhaps the "radical constructivism" associated with Ernst von Glasersfeld; it is a complex blend of philosophical/epistemological and psychological theses, and as "applied" in schools it yields, at its best, a range of practices not dissimilar to those advocated by Dewey and the more sensible progressive educators. Less well-known in the science and mathematical education communities, however, is the fact that there are scholars at work in other fields whose positions — while differing in important respects from that of the radical constructivists — are nonetheless broadly constructivist in orientation. Included in this latter group are feminist epistemologists, a few fairly mainstream epistemologists who are changing position somewhat, and various historians and sociologists of science. This presentation attempts to bring some order to this wider and richer scene by suggesting that the various types of constructivism can be spread out along five crucial dimensions — each dimension being composed of a major philosophical, psychological or social issue.

Phillips, Linda M.

Strand 2 — Mon, 24 Apr, 1995 8:30 AM Suite 2625

Taking a Critical Stance Toward Science Text: High School Science Students' Interpretations of Popular Reports of Science

Stephen P. Norris

The purpose of this study was to examine the way in which beliefs students possess before reading science text interact with and influence their interpretations. Ninety-one senior high school students who enrolled in at least one of Grade 12 Biology, Chemistry or Physics classes took part. Five popular reports of science were selected and, prior to reading each, students were asked a question dealing with their beliefs about the topic. They were then instructed to read the report and to answer a question dealing with their tendency to change the degree of certainty expressed in their response to the first question. Responses were coded and analyzed using descriptive statistics. Results showed that students' stated beliefs were marked neither by qualifications nor the recognition of alternative viewpoints. Also, students were likely to defer to or echo the texts. They offered few, poor, or no reasons for such deference and showed a marked tolerance for vagueness and ambiguity to the point where the meaning of their responses was very difficulty to discern.

Pirkle, Sheila

Strand 5 — Sun, 23 Apr, 1995 4:00 PM Nevada

Transforming Curriculum: The Evolution of a Collaborative Campus Renewal Project

Frank Cartledge, Kerry Davidson, Mary-Ellen Jacobs, James Wandersee, Exyie Ryder

This session will describe a curriculum transformation project intended to enhance undergraduate mathematics and science teaching at Louisiana State University and Southern University. This project is a part of an NSF-funded statewide collaborative project designed to promote reform in science and mathematics teaching. Eight Louisiana colleges and universities are currently participating in the project by developing campus-specific programs for undergraduate mathematics and science faculty. The ongoing collaboration of LSU and SU in campus renewal led to the formation of the "Alliance for Excellence in Science and Mathematics Teaching" in which both universities developed a coherent program of curriculum transformation. The program includes faculty seminars on the reform movements in science and mathematics teaching and learning, incentives for faculty to revise the curricula and opportunities for peer review of the new instructional techniques and course materials. Mathematics and science faculty are redesigning instructional materials and assessments using multi-media technology to make their large group instructional settings more student-centered and interactive. Qualitative research techniques such as journals, interviews and classroom observation are being used to determine the impact of the "Faculty Technology Seminars" on curricular renewal. Program participants will present their perspectives on the curriculum transformation program.

Pirkle, Sheila F.

Strand 6 — Sat, 22 Apr, 1995 7:00 PM Monterey

Science and More: For Middle School Girls Only

Judith Brun, Linda Rausch, Mary-Ellen Jacobs

This paper describes a research project which investigates the effects of a year-long integrated mathematics and science education program for forty culturally diverse Grades 6, 7 and 8 girls and their parents. The girls attended three weeks of summer camp and participated in Saturday programs during the school year. The parents spent a day at summer camp and attended the Saturday sessions with their daughters, participating in cooperative learning groups. The curriculum materials included interactive, computer-generated mathematics materials, SEPUP and other hands-on lab activities. Pre and post tests of student attitudes and mathematics problem solving competency were used to evaluate student achievement. Portfolios of student graphs and written work were analyzed. Findings included: (1) substantial (20%) improvement in problem solving skill on the mathematics test, (2) improvement in facility in computer skills, (3) increased use of charts and graphs to organize data collected in lab investigations and, (4) self-reported improvement in competency in problem solving. The program is now in its third year and has been incorporated into a high school academic year program. The results of the program extension are emerging. They appear to confirm the results of the study described here.

Plucker, Jonathan A.

Strand 5 — Sun, 23 Apr, 1995 10:30 AM California

Teaching Invention and Design: An Exploratory Study

Michael Gorman

This study determined the impact upon gifted high school students of a course on invention. The three week long course involved 31 students who were required to invent specific products (e.g. a telephone), create working prototypes and present their invention to a "patent examiner". Interviews, Likert scale and open-ended surveys, journals and observations were used to collect data. As a result of the course, attitudes toward invention became more realistic and students improved in their ability to work with their peers. While student attitudes toward the importance of reflection improved, a heightened use of reflection was not observed in the students' inventive processes.

Pollard, Rebecca J.

Strand 5 — Mon, 24 Apr, 1995 2:30 PM Monterey

Test-taking Strategies: The Relationship between Item Difficulty and Performance

Student test performance was examined as it relates to testing-taking strategies. Inspection of the test-taking strategies used on open-ended type physics questions were related to item difficulty and student performance. It was found that item difficulty was not related to either individual test-taking strategies or to the overall use of test-taking strategies. Further, it was found that student performance was not related to either individual test-taking strategies or the overall use of test-taking strategies. However, student performance was shown to be predicted by relative strategy use on the items that students found to be difficult.

Powell, Richard R.

Strand 3 — Sun, 23 Apr, 1995 1:00 PM Gold Rush A

The Social Construction of Textbook-centered Science: A Cross-case Analysis of Second-career and First-career Beginning Teachers

The purpose of this study was to explore how prior knowledge and biographical experiences of a second-career teacher, who had been a field hydrogeologist in his first career, influenced his classroom learning environment. To achieve this purpose I focused on: (1) how his knowledge of science and how his beliefs about teaching science were transformed into classroom instruction, (2) what school and classroom factors influenced this social transformation process, and (3) the relationship between this process and his classroom curriculum. Case study methodology and the constant comparison method of data analysiswere used in a year-long cross-case analysis between the second-career teacher and a first career science teacher. Data analysis generated three themes reflective of the teachers' efforts to socially construct a classroom curriculum. Implications for developing classroom science curricula are discussed.

Pyle, Eric J.

Strand 10 — Sat, 22 Apr, 1995 7:00 PM Suite 2625

Motivation and Social Cognitive Development in Informal Science Education Environments: A Developmental Study

Research in Informal Science Education (ISE) environments in the past has largely been limited to evaluations of impact on learning of particular science museum environments or community-based program. Motivation for participation has been assumed to be intrinsic, without considering such motivation in a larger context of social interactions. This study applies a framework of motivation theory and social cognitive development to the actions of middle school students as they choose to participate in one of three ISE venues: a science/technology center, a science-dedicated store and a hobby group that requires the use of mathematics and science. A total of 30 students, along with 19 parents and 9 location staff were interviewed using an open-ended protocol, examining student motivational orientations, evaluations and affect. From these data it was observed that more than one motivational orientation was in operation at a given time, that student-adult interactions were reflective of stages of self-regulated learning and that student evaluations were tied to their subject norms (what others think they should do) and motivational cues. The results of this study will be used to identify points of convergence between ISE and Formal Science Education (FSE).

Ralston, Susan

Strand 3 — Sun, 23 Apr, 1995 8:30 AM Carmel

Three Beginning, Urban, Secondary Science Teachers' Evolving Understanding of the Nature of Science

Ruth Bombaugh — John Sowder — Hans Sowder

This longitudinal, descriptive study focuses on three beginning teachers' understandings of the nature of science during their first two years of practice in an inner-city classroom. All three secondary-level science teachers, two males and one female, brought with them 2-3 years of previous teaching experiences from their Peace Corps service in third-world nations as well as undergraduate degrees in a life-science area. Ethnographic data collected during the first year by the teacher-educator supervizing the three teachers included classroom observations, teacher journals, class projects and perhaps most importantly, multiple interviews of the teachers and single interviews of their university instructors and school-site colleagues. During the second year, the teachers participated in a voluntary focus group which met five times to discuss readings in students' understandings of science, philosophy of science and constructivist teaching. They then designed a lesson plan in response to a personally relevant issue from the readings and analyzed a transcription of the implementation of their lesson plan. The results are reported in three case studies.

Reap, Melanie A.

Strand 5 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Project EARTHSTORM: Integrating Real-time Weather Data into the Science Classroom

Georgianna Saunders Ann M. L. Cavallo

Project EARTHSTORM (Earth-system Education Science Teachers using the Oklahoma Regional Mesonetwork) was a three year NSF sponsored project that prepared middle school science and mathematics teachers to use environmental data from automated monitoring systems (Mesonet) to expand and enhance students laboratory-based experiences. During EARTHSTORM summer institute teachers were involved in active instruction of meteorology and related topics, computer applications and presentation of a laboratory-based curriculum model (the learning cycle). A comprehensive curriculum guide was developed by the teachers and staff for teaching meteorology and related topics to middle school students. A field test version of the curriculum was disseminated to EARTHSTORM teachers. Teacher input on the curriculum will continue throughout the 1994-1995 school year. This paper presents the curricula, specific applications using the Mesonet data and the findings of research.

Reinhold, Peter

Strand 1 — Mon, 24 Apr, 1995 8:30 AM Nevada

Open Experimenting — A New Approach to Teaching and Learning Science

As empirical investigations show, the effectiveness, relevance and acceptance of labwork and instruction based on experiments, is strongly questioned by research. Therefore a radical restructuring of the role of the experiment in science teaching has been demanded. But, how should learners experiment to acquire both a knowledge of physics and an adequate methodical and epistemological knowledge about physics in such a concrete manner that they are able to apply their knowledge in new contexts? How can they be motivated so that meaningful learning occurs and so that they construct knowledge based on what they already know? This was the main question of a program called "open experimenting". Guided by activity theory, constructivism and the concept of system formation, a theoretical framework for open experimenting and several experimental examples were developed and tested in seminars, where the student teachers were exposed to the new approach. Case studies applying a qualitative and interpretive research method were performed to support the approach and to develop specific structural elements of open experiments which can be used as an instructional guideline.

Rennie, Léonie

Strand 6 — Mon, 24 Apr, 1995 8:30 AM Emerald

Gender and Science: Recasting the Long Shadow

Lesley Parker Jan Harding Doris Jorde Jane Butler Kahle
Thomas Koballa, Jr Tina Jarvis

The objective of this symposium is to use an interactive session to bring together a variety of informed research perspectives on the relationships between gender and science, with a view to promoting an understanding of the perceptions, realities and initiatives which can lead to the closing of the gap between policy and practice. The individual presentations originate in four different countries and hence in different social and education contexts. They offer current perspectives about gender and science in the context of the realities of practice in schools and identify the perceptions and attitudes which may impede the implementation of policy and change.

Rennie, Léonie

Strand 5 — Sun, 23 Apr, 1995 1:00 PM Suite 2625

The Effect on Student Performance of Placing Physics Problems in Real-life Context

Lesley Parker Leonie Maley

This study investigates the effect of the presence of context in physics problems by comparing the performance of physics students on two sets of matched problems: Set A, in which the problems are embedded in a real-life context and Set B, in which the problems are abstract, written without reference to real-life events or objects. Eight high school students, four boys and four girls, completed the A and B problems alternately, with two boys and two girls randomly chosen to do the Set A problem first. Students were interviewed in groups of four about their reactions to each problem. The results show that boys and girls performed equally well on the tasks with and without context. The ability "to visualize" what the problem is asking is an important aspect of successful problem solving and real-life context plays a significant role in this aspect of task performance. Problems with context are generally perceived to be more interesting, provided the context is relevant and not contrived. Irrespective of the presence of absence of context, tasks requiring written answers rather than calculations were perceived to be more difficult, underscoring the importance of considering item format, as well as context, when preparing gender-inclusive assessment tasks.

Reyes-Garcia, Carlos A.

Strand 9 — Sun, 23 Apr, 1995 1:00 PM Washington

Aspectos y Consideraciones del Reconocimiento Automatico del Habla Espanola

Ramón Alberto Mata-Toledo

El propósito de este artículo es el de presentar un panorama general del campo de la Inteligencia Artificial denominado Reconocimiento Automático del Habia (Automatic Speech Recognition), sus problemas inherentes, procesos fundamentales de operación, y sus particularidades cuando se aplica al idioma español.

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Reyes-Garcia, Carlos A.

Strand 9 — Sun, 23 Apr, 1995 8:30 AM Emerald

Aspects and Considerations of the Automatic Speech Recognition of Spanish: Artificial Intelligence

Ramon A. Mata-Toledo

English presentation of the topic above.

Reyes-Herrera, Lilia

Strand 9 — Sun, 23 Apr, 1995 1:00 PM Washington

Ensenanza de las Ciencias: Aproximacion Sociocultural

Gloria Jiménez

El presente trabajo intenta identificar algunos aspectos socioculturales que influencian la enseñanza de las ciencias en un aula de clase en Bogotá, Colombia. Utilizando un marco teórico de naturaleza constructivista y trabajando metodología etnográfica traté de clarificary hallarle sentido a las creencias que este profesor posee y que inconscientemente orientan su practica educativa. Las implicaciones de esta investigación son muy significativas para docentes que estando en las misma situación de este profesor y reconsiderando su papel como docentes deseen construir un nueva pedagogía que propicie el desarrollo de un nuevo ciudadano colombiano.

Reyes-Herrera, Lilia

Strand 9 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

The Teaching of Science: A Sociocultural Approximation

English presentation of the topic above.

Rice, Diana C.

Strand 4 — Tue, 25 Apr, 1995 1:00 PM Washington

Elementary Science Instruction: Are Teachers Prepared to Teach What Their Students Must Master?

Margaret R. Corboy

The purposes of this study were: (1) to explore the knowledge of preservice elementary teachers of a set of sample items from the South Carolina Basic Skills Assessment Program (BSAP) Science Test given to Grades 3, 6, 8 and, (2) to identify variables related to scores on these items. Three groups of participants completed an instrument including the nine science items and a measure of reasoning ability (TOLT): 74 student teachers, 57 inservice teachers and 35 students in a preprofessional course required for all education majors. Other variables examined were age, number of years of experience, number of science courses completed, type of education major. Overall, participants performed well on the nine elementary science items. Secondary education majors scored significantly higher than elementary/early childhood majors on the science items and on the test of logical thinking (TOLT). In addition, reasoning level was found to be significantly related to performance on the nine science items; however, number of science courses taken was not. Implications for admission standards for elementary/early childhood programes and for science requirements within those programs are discussed.

Richardson, Lon

Strand 8 — Tue, 25 Apr, 1995 1:00 PM Emerald

The Need for a Biologically-based Epistemology

Researchers must carefully weigh, claims regarding the propositions they are willing to classify as researcher and/or teacher knowledge. The problem is, what should count as epistemic justification? Because there is a fundamental difference in constructing knowledge of objects or events and constructing knowledge people hold about these objects or events, science education researchers must develop an epistemology which better corresponds to what can be known regarding the mind and its constructs. We must move from a physics-based epistemology to a biology-based epistemology. Such an epistemology would have several possible tenets: (1) denial of teleology, acceptance of teleonomy, (2) the mind is a product of evolution and has value-based constraints, (3) perception may be constrained by morphology, (4) human descriptions may never match the complexity of nature, (5) many events are irreversible, and (6) each person's belief/knowledge structure is unique and experience-based.

Richmond, Gail

Strand 2 — Sun, 23 Apr, 1995 1:00 PM Nevada

A Closer Look at Conflicting Expectations Embedded in Group Work: Profiles of Two Students

Joanne Striley

This study was designed to investigate the discourse of 24 students as they worked on designing, implementing and interpreting experiments in a Grade 10 integrated Science class. Observations were carried out over a three-month period and were made of six groups of four students conducting four laboratory investigations; the audiotaped and videotaped discourse and other interactions of two of these groups were analyzed. In particular, our analysis focused on the relationship of an academically successful student in one of these groups and a special education student in another with others in their group. We found that there were both positive and negative consequences of engaging in group work for these individuals far beyond what we were cognizant of as their instructors and as researchers. These patterns were in large part the result of roles which were assumed by students in the groups and by the conflicting expectations which resulted from the execution of these roles. The nature of these patterns, as well as the implications for group productivity and individual cognitive and social benefits will be discussed.

Riggs, Iris M.

Strand 4 — Sat, 22 Apr, 1995 7:00 PM Redwood

The Characteristics of High and Low Efficacy Elementary Teachers

This study was designed as a preliminary step in identifying characteristics of teachers with varied levels of science teaching outcome expectancy and self-efficacy beliefs. Beliefs of 57 teachers were measured using the Science Teaching Efficacy Belief Instrument (Riggs, 1988). Three to five outliers (high and low) on both self-efficacy and outcome expectancy were identified. Teacher types were compared on a multitude of variables such as time spent teaching science and attitude toward professional development in science. Results describe a possible profile of teachers with high or low beliefs which should guide further investigations.

Riley, Dana

Strand 10 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Exploring Students' Constructed Perceptions of Science Through Visiting Particular Exhibits at a Science Museum

Jane Butler Kahle

The purpose of this study was to begin investigating how students construct their perceptions of science through visiting particular exhibits at a science museum. Upper primary school students were requested to interact with particular exhibits during a school group visit. Two weeks after their visit, students were interviewed regarding their preference of exhibits and which they believed taught them science the best. Analyzed through a feminist perspective, this study concludes with a working hypothesis suggesting that science museum exhibits have the power to legitimize untraditional ways of constructing perceptions of science.

Riley, Joseph

Strand 5 — Sun, 23 Apr, 1995 4:00 PM California

Does a Summer Leadership Program Make a Difference? An Application of the PACE Model to the Georgia ST3 Leadership Program

Science Teachers Training Teachers (ST3) is a collaborative effort between the Georgia Science Teachers Association (GSTA) and the University of Georgia to improve elementary science instruction in Georgia. The STY3 program provides leadership training for elementary, middle and secondary science teachers interested in sharing their classroom experience and specialized training with colleagues. Participants completing the training program become part of a select Teacher Leader Cadre (TLC) charged with conducting elementary science workshops throughout the state. A pretest/posttest evaluation model was presented to teacher workshop leaders during their training. They were encouraged to use the same measures and procedures to assess the effectiveness of their own workshops. Evaluation of the first cadre of workshop presenters indicated that although they conducted over 40 workshops, few made use of the pre and post tests provided. Interviews with the teacher leaders indicated that in general they felt reluctant to "hold their peers accountable" for program objectives.

Riley, Joseph P.

Strand 4 — Tue, 25 Apr, 1995 1:00 PM Nevada

Examining the Multiplier Effect of a Statewide Elementary Science Inservice Program

Tom Elliott **Lisa Gansar** **Lena Lane**

This study evaluates results of a three year state wide inservice program designed to enhance the content pedagogical knowledge of elementary science teachers. The program prepared a cadre of 70 teachers to conduct elementary science workshops in their local school districts. The study focuses on the identification of factors that influence the intended multiplier effect of teacher inservice programs. The multiplier effect refers to corollary actions resulting from some initial effort. It is a means of leveraging effort. In teacher inservice programs, it is usually accomplished by requiring that participating teachers conduct similar inservice programs at their school or district level. Little research is available describing factors that might influence the multiplier effect. Using quantitative and qualitative analysis, this study examines factors such as teacher personalogical variables, teacher knowledge, school and/or district contexts, resources, collaborative efforts and administrative support to assess their influence on participants' success in producing a multiplier effect.

Rillero, Peter

Strand 2 — Tue, 25 Apr, 1995 2:30 PM Washington

An Evaluation of a Hands-on Science Homework Program for Sixth Grade Students and Their Parents

Stan Helgeson

This study evaluated an at-home, hands-on science, parent-involvement program for six grade students using a quasi-experimental, control-group design with classes randomly assigned to the control and treatment group. Descriptive data were collected on attitudes toward the program and levels of participation. Comparisons between experimental groups were made for students' attitude towards science, students' science process skill achievement and measures of parent involvement. Two teachers and eight sixth grade classes from central Ohio participated (N=200). Treatment group students, as part of the Student Parent Laboratories Achieving Science at Home (SPLASH) program, received ten hands-on science homework assignments requiring their parents' participation. Control group students received traditional homework. The activity rates of completion began at a high level and declined during the program. A majority of program questionnaire respondents expressed positive opinions about aspects of the program. Most students preferred SPLASH to traditional homework and most would rather work on SPLASH with a parent. A majority of respondents felt the student had learned from doing the activities. However, there were no significant differences between experimental groups on two science process skill instruments. There were no significant main effects for experimental group on the science attitude instrument.

Ritchie, Stephen M.

Strand 2 — Tue, 25 Apr, 1995, 2:30 PM, Washington

Student Engagement in a Laboratory Research Project

Donna L. Rigano

There has been a long tradition of laboratory activities associated with science instruction. In spite of constructivists' claims advocating open-ended inquiry and mentoring, little is known about what students are thinking when engaged in laboratory activities. The purpose of this study was to investigate the thinking of senior high school students undertaking a research project in a chemical engineering laboratory supervised by a university mentor scientist. Data from a variety of techniques were analysed in an interpretive style. We conclude by recommending that students should experience a range of teaching/learning strategies and contexts, including open-ended inquiry and that these should be matched to the learners' needs and purposes of instruction.

Robeck, Ed

Strand 6 — Mon, 24 Apr, 1995, 2:30 PM, Suite 2625

Representing a Gender Equity Project: Pedagogical Approaches and Methodological Concerns

Jim Gaskell Gary Hepburn

This presentation will be a performance of a single paper that gives the appearance of a multiple-paper presentation in which the three papers refer to the same project and data set. The presentation of what seems to be each distinct paper will be productively interrupted so that queries can be inserted into what would otherwise be an ideologically seamless report. It is, therefore, a performance of three analyses which will create the effect of an ongoing discussion of the project making uneasy any sense of disclosure. Many of the key points will be raised by the perturbations and sense of transgression generated by these interruptions and in the relationships among the analyses. We will, therefore, utilize "a creative collision of incommensurable voices that do not map onto one another" (Lather, 1992) in an exploration of both the substantive and methodological issues in gender equity research in science education.

Robinson, Scott

Strand 4 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

A Narrative of a First Year Science Teacher

My purpose is to fashion a narrative of a critical episode in the life of a first year Science teacher. The story is created from my experiences with a student teacher. Data are constructed from observing him teach, formal and informal interviews and his critical autobiography describing a few significant educational events in his life. I set out to interpret the meaning of teacher actions from the teacher's perspective. I agree with Eisner (1991) that qualitative inquiry is to offer an interpretation pertaining "to what experience holds for those in the situation studied". The narrative begins in an honors Biology classroom. Students express dismay at their recently graded laboratory reports. The plot turns to the teacher's reflection and deliberation on potential strategies to resolve the dilemma. He decides on a science process lesson in which students re-interpret their laboratory findings. The teacher is a conscientious and caring professional (Noddings, 1984, 1992). He "accepts the students feeling toward the subject matter" (Belenky, Clinchy, Goldberger & Tarule, 1986). Students are treated as independent knowers. The teacher facilitates learning based on student interests and motivations.

Rodriguez, Alberto J.

Strand 4 — Mon, 24 Apr, 1995, 2:30 PM, California

Caught between a Rock and a Hard Place: Managing the Dilemmas of Learning to Teach Science

The purpose of this study was to investigate the dilemmas preservice science teachers encounter in relation to their participation in a project which sought to establish a constructivist and collaborative model of teaching and learning science. I gathered information by conducting five interviews with each of the six preservice teachers over the 12 month period of their professional preparation. In addition, I had many informal conversations with them and observed them several times during their university and school practicum experiences. Six dilemmas were identified in relation to the roles the participants felt they needed to perform during their school practicum. The variety of dilemmas the pre-service teachers encountered and the direct and indirect strategies they implemented to manage those dilemmas are explained in terms of two overarching issues: the need to bridge the theory and practice of learning to teach in two distinct communities of practice and the type of relationship the preservice teachers established with their advisors. I conclude by providing a series of suggestions for assisting preservice teachers build better conceptual bridges between the two communities of practice to which they belong.

Rodriguez-Munoz, Marisol

Strand 6 — Tue, 25 Apr, 1995, 8:30 AM, Suite 2601

Linking Scientific Literacy and Language Development in a Bilingual Setting

The objectives of this study were to generate empirical data: (1) on how scientific literacy is exhibited and facilitated in a bilingual classroom and, (2) on how scientific concepts and language development interact in such classes. Two cluster samples of fourth grade students who had received science instruction in Spanish for at least three consecutive years in a Midwestern inner city school comprised the sample for this study. For a period of six months after the beginning of the academic year, science units in the areas of Biology, Chemistry, Geology and Physics were videorecorded. Transcripts of the lessons were analyzed for indicators of scientific literacy (as defined by the American Association for the Advancement of Science Project 2061) and of language development. Results reveal a disparity between the development of scientific concepts and linguistic development. Instruction which provides an array of opportunities for the support of receptive and productive skills tends to minimize this disparity.

Roeber, Edward D.

Strand 5 — Sat, 22 Apr, 1995, 7:00 PM, Gold Rush B

The Collaborative Development of Science Assessments: The SCASS Experience

Charles Warren, Jeff Greig, Dan Ochs, Rolf Blank

The development of student assessments in areas such as science is being encouraged nationally by reform policies that establish higher standards for students and the professional development needed to help teachers provide appropriate learning opportunities to students. A key aspect of this systemic reform is improving the assessment used at the classroom, district and state levels to measure student performance. The SCASS Science Education project, in which 13 States are participating, represents a landmark collaborative effort to help states work together to build a variety of assessments, to do so building on each others' experiences and perhaps at lower cost. This session will provide an overview of this challenging collaborative project being facilitated by CCSO. Presenters will provide an overview of states' experience of working together on the initial phase of the project and the work underway in the second phase.

Rogers, Laura N.

Strand 1 — Mon, 24 Apr, 1995, 2:30 PM, Nevada

Conceptual Organization of College Biology Students

Susan L. Westbrook

This study was conducted to examine the implementation of concept mapping by students enrolled in an introductory Biology course at a community college in North Carolina. Students prepared concept maps from the content of assigned sections of the textbook and were asked to incorporate laboratory activities and personal experiences. Variables considered included: (1) spatial/relational organization of terms and links within the map, (2) the types of links made between terms, (3) students' performance on exams, (4) students' final course grade, (e) students perceptions of the mapping assignments and, (5) instructor's perceptions of the mapping assignments. Students' success in the course was positively correlated with concept maps in which the organization was comparable to the textbook's organisation and/or showed a high level of valid propositions and cross links. Students' perceptions of the mapping assignments were generally negative; mapping was considered too difficult and out of line with the studying needed to do well in the course. The instructor's perceptions were that concept mapping; (1) provided useful formative data about the students' difficulties with content, (2) often stimulated class discussions and, (3) provided students with valuable self-assessment data. Implications for further research are given.

Ron, Salit

Strand 2 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

Learning Environment and Academic Achievement of High School Students Who Learned Evolution in a Cooperative Mode

Reuven Lazarowitz

It has been found in high school classes of Biology that cooperative learning influenced some aspects of the learning environment and that the learning environment was related to academic achievement and the motivation to learn. The purpose of this study was to measure changes in academic achievement and in the perception of the learning environment among high school students who learned evolution in small inquiry groups. A learning unit on evolution was developed in which the learning material integrated the biological contents and the instructional method. The sample consisted of Grades 11 and 12 students (8 classes; N = 152). Seven classes learned the topic of evolution in a cooperative mode and one class learned in a frontal approach. The study lasted four weeks. A multiple choice questionnaire and Learning Environment Inventory were used for students' assessment. Pre and post mean scores were analyzed in a nested design with ANCOVA for difference. The results show that students who learned in small inquiry groups attained higher achievement scores on the evolution topic than students who learned in a frontal approach. The learning environment of experimental group was less competitive, task oriented and more rewarding.

Rop, Charles

Strand 2 — Sun, 23 Apr, 1995, 2:45 PM, Oregon

Success in High School Chemistry: What Does It Mean and What Does It Take to be a Good Student?

The purpose of this study was to hear the voices of college-bound high school students concerning meaning and action in cultural context. Students explain what it means to understand and to succeed in introductory chemistry. The method was ethnographic and interpretive as the researcher took on the role of participant observer in introductory chemistry classes in two Midwestern public high schools during one school year. A focus group of students from each school and the two teachers were interviewed and participated in informal conversations. Field notes and interviews were considered primary data sources. Audio tape transcriptions and written artifacts served as secondary sources. Students explained that understanding is necessary for success. Results indicated that they defined understanding in at least two ways, one practical and task-oriented, while the other definition was theoretical and epistemological. Success associated with the latter understanding was elusive yet considered more meaningful.

Roth, Kathleen J.

Strand 6 — Sun, 23 Apr, 1995, 8:30 AM, Nevada

Exploring the Role of Self in Science and Science Education: Feminist Perspectives and Women's Stories

Angela Barton, Lynne Cavazos, Lori Kurth, Deborah Smith, Elaine Oren, Constanza Hazelwood, Gail Richmond

Using autobiographical inquiry methods, this group of women science educators constructed a set of stories that examine the ways our identities and our roles in science education have been shaped by social constructions. This research approach enabled exploration of dominant discourses about self, science, science education and research and urged the recreation of alternative ways of conceptualizing our roles and identities in the field of science education. In this interactive session, presenters will stimulate discussion by sharing autobiographical stories that reveal ways in which the self was silenced, disguised or distorted to fit into the science education community. Discussion will be organized around the questions: How can feminist theory and pedagogy help us explore ourselves in ways that enable us to reexamine and recreate our relationships with science and science education? What are the implications of such explorations for our work as teachers and learners of science, as science teacher educators and as science education researchers? Participants will choose to join one of three discussions groups: teacher education, research, science teaching and learning. Feminist lenses suggest that there may be ways we can reconstruct science and science education in ways that are more inclusive and liberatory. The purpose of this session is to begin an ongoing conversation about these alternative perspectives.

Roth, Wolff-Michael

Strand 3 — Mon, 24 Apr, 1995, 10:30 AM, Suite 2601

A Case Study of the Theoretical and Practical Knowledge Constructed by Two Teachers while Team-teaching an Engineering Unit

In many fields, practitioners learn significant portions of their job-related theoretical and practical knowledge while they participate with more competent old-timers. Taking this as a precedent, we designed the present study to construct an understanding of the theoretical and practical knowledge important to teachers in the practice of teaching by observing two teachers who collaboratively taught an engineering unit. For this interpretive study, we video-taped all engineering lessons over a three month period, the debriefing meetings with one or both teachers and/or those with other teachers who observed the lessons. We constructed three major dimensions of knowledge relevant to teachers' practice. First, we found that participation in ongoing activity, understanding and learning were intricately bound up with each other; important aspects of teacher knowledge remained unarticulated. Second, watching videotapes and debriefing lessons allowed teachers to articulate practices and to link their practices to propositional knowledge that they had heard about previously, but that had not affected their practice. Finally, when teachers attempted to implement theoretically derived precepts they struggled with finding a balance between apparently competing generalisations. The findings allowed us to construct a theory of teaching as practice.

Rowell, Patricia M.

Strand 4 — Sun, 23 Apr, 1995, 4:00 PM, Redwood

Planning to Teach Elementary School Science Lessons: A Study of Preservice Teachers' Preparation and Action

Sandra Guilbert

The purpose of this study was to explore the priorities and concerns of preservice teachers' in planning and teaching during a school-based science education assignment in their teacher education program. Participants' beliefs about learning in science were documented and classroom practices interpreted in light of the planning which was done. Data sources included classroom observations and transcripts, interview transcripts, reflective journals and children's writing. Interpretation of the data suggests that these preservice teachers had difficulty recognizing key concepts associated with instructional topics, persisted with hands-on only approaches to science teaching and learning and perceived instructional sequences as teaching situations rather than opportunities for learning.

Roychoudhury, Anita

Strand 3 — Sun, 23 Apr, 1995, 1:00 PM, Gold Rush A

Development of Content Knowledge and Pedagogical Content Knowledge of Prospective Elementary Teachers

Deborah Tippins

The purpose of this two part study was to examine changes in the views of preservice teachers in the domains of content knowledge and pedagogical content knowledge. Using microgenetic methods, the first part of the study explored the development of content knowledge of preservice elementary teachers enrolled in a physical science course. Data, which were gathered over eight weeks, consisted of preservice teachers' weekly reports about weather, including questions they asked about weather, data they collected on the questions, and their reflections about this process. The second part of the study examined pedagogical content knowledge of the preservice teachers. In this second part preservice teachers wrote classroom cases during student teaching, which provided the means to explore the development of their pedagogical content knowledge.

Ruiz-Primo, Maria A.

Strand 5 — Sun, 23 Apr, 1995, 1:00 PM, Redwood

Reliability and Validity of Performance Assessments

Richard J. Shavelson

Over the past five years, a team of researchers at the University of California, University of Michigan, the California Institute of Technology and the Pasadena Unified School District have developed and evaluated performance assessments in science. The team has explored the development of science performance assessments and evaluated their reliability and validity. It has also investigated the exchangeability of different assessment methods. Both the good news and the bad news will be presented in the light of the implications they have for large-scale assessment. For example, regarding reliability, the good news is that raters are able to reliably score students' performance; the bad news is that more than six tasks are needed to obtain a reliable estimate of student achievement. Regarding validity, the good news is that performance assessments can distinguish different instructional histories; the bad news is that to be instructionally sensitive, these assessments must tap students' declarative as well as procedural knowledge. Likewise, regarding assessment and the methods for developing those types of assessment; the bad news, however, is that with all the experiences that were gained, assessment development is still a long process of review and revision.

Rye, James A.

Strand 5 — Sun, 23 Apr, 1995, 10:30 AM, California

A Science-Technology-Society (STS) Critical Issues Course for General Studies Natural Science Credit: The Evaluation of a Pilot Offering

Peter A. Rubba **Leonard Waks**

The purpose of this study was to evaluate the pilot offering of an interdisciplinary course, developed through a project funded by the National Science Foundation that focused on critical issues (global worming, energy options for the future and biodiversity conservation) in Science, Technology and Society (STS). The course responded to the call of The Study Group of the American Association for the Advancement of Science (AAAS) on General Education for "radical reform" of the natural science general education component of the undergraduate curriculum. The study was conducted by two science educators who had prolonged engagement with the course and attempted to carry out a "practical evaluation" that involved stakeholders and was creative yet situationally responsive. The study employed in-depth interviews and observations of class sessions to reveal the efforts and insights of the natural science and STS faculty who taught the course and the perspectives and understandings of enrolled students. Students believed the course should fulfill general studies science requirements due to the diversity of and interrelationships between course topics, yet faculty cited the need for instruction to draw tighter connections between the critical issues. Twelve assertions and recommendations emanated from the findings and will inform future course offerings.

Ryu, Tae

Strand 10 — Sun, 23 Apr, 1995, 10:30 AM, Crystal

Factors Affecting Student Choice of Career in Science: Different Approaches to Teaching Science in Japanese Schools

Miyuki Tanaka **Chiyoko Yuki** **Hiroyoshi Kinoshita** **Kazuhino Akao**

In Japan, in order to investigate the factors affecting school success in producing engineers and scientists, a questionnaire was sent to teachers and third year (Grade 12) students in 70 high schools; 59 of them responded producing 5556 student responses. Ten schools were visited to interview 30 teachers and 100 students. A second teacher questionnaire was subsequently sent to the 59 schools. After analysis of the qualitative and quantitative data from the schools, it was found that preparation for examinations discouraged the promotion of student centred learning. This paper gives case studies of two different types of school; school A which puts priority on the performance in university entrance examinations and, school B which puts priority on stimulating students' curiosity about science.

Said, Safian

Strand 10 — Sun, 23 Apr, 1995, 1:00 PM, Monterey

Visionquest: Teachers' Perceptions of Reform in Science Education

Dana L. Zeidler

The purpose of this study was to discern high school teachers perceptions of, and commitment to, the contemporary goals of science education. The 331 teachers who responded to the Contemporary Goals Survey were selected from 64 schools in 26 States. Appropriate validity and reliability are reported. Findings suggest that a minority of subjects hold past goal orientations as strongly as those holding the majority view and resist the introduction of moral issues, integration among subjects and heterogeneous grouping practices. Discriminant analysis also indicated that professional development factors, familiarity with science education journals and years of teaching science were moderately predictive of contemporary goal orientation. Implications related to reform issues and research are discussed.

Salmi, Hannu S.

Strand 10 — Sat, 22 Apr, 1995 7:00 PM Suite 2625

Science Center Education: Motivation and Learning in Informal Education

The purpose of this study was to investigate learning in a science exhibition in order to further develop the theory of science centre education as a form of informal education. The subjects (N:130) of this study consisted of six comprehensive school classes of 7th graders in the greater Helsinki area. The design of the study was quasi-experimental with two different pre-treatment groups (intrinsic vs. instrumental motivation). The situation motivation group was the control group. The classes were tested by a common intrinsic/instrumental motivation test and by a specific situation motivation test measuring the exhibition experience. The knowledge test measured the effects of a pre-lesson, the learning of isolated facts and the learning of entities. Tests were administrated three times during a nine month period. The intrinsic treatment group was the most positively motivated towards the exhibition. The difference from other groups was statistically significant (.05) and long-lasting. The results showed that the intrinsic treatment group did best in nearly all cognitive tests. In particular, the group's ability to learn entities suggests a deep learning strategy.

Sanders, Jo

Strand 4 — Tue, 25 Apr, 1995 2:30 PM Oregon

Accounting for Profound Educational Change in Gender Equity

This paper describes the transformative effect of participation in the Teacher Education Equity Project, a large nationwide NSF-funded project designed to assist 60 professors of science, mathematics and technology education, from Alaska to Florida, to teach their preservice students gender equity awareness and skills before they enter the classroom. Gender equity in education in these areas has generally received little attention at the teacher preparation level in contrast with much activity at the K-12 level, and this project contributes to filling the breach. Ms. Sanders, the Project Director, will analyze the main factors leading to change in this sensitive and difficult area and will present information on *Gender Equity in Preservice Science Education, Gender Equity in Preservice Mathematics Education and Gender Equity in Preservice Technology Education,* which will be published in 1996 and other resources for teacher educators.

Scharmann, Lawrence C.

Strand 2 — Mon, 24 Apr, 1995 2:30 PM Washington

Science Teaching Self-Efficacy of Preservice Elementary Teachers as Influenced by Heterogeneous Grouping

Colleen Hampton

The influence of cooperative grouping on the science teaching self-efficacy of preservice elementary teachers, enrolled in a science methods course, was examined. Participants responded to a science teaching efficacy belief instrument (STEBI) at the beginning and mid-point of the semester. Extensive observations of laboratory sessions were also made by one of the investigators. Cooperative grouping was accomplished in the laboratory sections. Two of four laboratory sections were randomly designated as "experimental", comprised by one high, one low and 1-2 moderate STEBI scoring individual(s). Cooperative learning groups in one of the two remaining laboratory sections were formed by random draw, while the fourth utilized a self-selection process. Analysis of the posttest results indicated that there were no significant differences between the self-efficacy scores of those in the experimental sections and those in either the random draw or the self-selected sections. However, anecdotal records and the reduction of extensive participant-observer data indicated that the experimental groups exhibited more enthusiasm during the laboratory sessions and showed less variation in the quality of their peer teaching presentations. It was concluded that heterogeneous grouping based on science teaching self-efficacy shows promise pending further investigation.

Schauble, Leona

Strand 2 — Sun, 23 Apr, 1995 10:30 AM Gold Rush A

Thinking About Simple Machines: Model-based Reasoning in Design Contexts

Richard Lehrer

As part of a project concerning the development of model-based reasoning, we track the process by which children invent or appropriate models and notations in the context of team-centered, project-based design of inventions made with gears. We compare growth of elementary-school children's knowledge in three contexts: individuals solving structured problems, collaborative pairs solving experimenter-posed design "challenges" and a design team working with an adult to design and construct their own inventions. Children's conceptions about gears varied from anthropomorphic interpretations to mathematical models based on gear ratios. In the individual context, knowledge was composed of poorly connected pieces of experience and rules. Children best understood direction of motion a speed of turning and finally mechanical advantage. Although these ideas were central in the challenge posed to the pairs, the dyads made little progress without teacher assistance and other children to help in generating and evaluating problem solutions. The adult played a key role in helping design team members reflect on their designs. Progress here depended on the inventions children chose to make and the roles they assumed.

Schmidt, Hans-Jürgen

Strand 1 — Sun, 23 Apr, 1995, 8:30 AM, Redwood

Ambiguous Chemical Terms: A Source for Students' Misconceptions

The present study is based on the hypothesis that ambiguous terms commonly used in chemistry textbooks would be a source of senior high school students' misconceptions. The aim of the study was to identify the misleading power of certain trivial names for organic compounds. Many trivial names end in a syllabus that hints at the wrong class of compounds within the systematic nomenclature. The terms to be studied were taken from a list of chemical terms based on the vocabulary of a chemistry textbook. Multiple-choice and open answer questions were developed and administered to senior high school students at the beginning of the school year 1994/1995. The students were asked to give reasons for their answers. The result was that students were guided by ambiguous terms to the predicted wrong answers and that they reasoned accordingly. For example, they identified acetylene as an alkene because of the ending "-ene". Students should learn in their chemistry classes to appreciate the predictive power of systematic names for organic compounds and how it came into being that systematic and trivial names are used simultaneously.

Schmidt, William H.

Strand 5 — Mon, 24 Apr, 1995, 8:30 AM, Gold Rush B

Many Visions, Many Aims: Curriculum and the Creation of Science Educational Opportunity

Charles Rop Edward Britton

The Science Curriculum Analysis is a significant aspect of the Third International Mathematics and Science Study. TIMSS is a ten year international comparative study of mathematics and science education being conducted in approximately 50 countries under the auspices of the International Association for the Evaluation of Educational Achievement (IEA). The data are exhaustive, page-by-page inventories of the contents, student performance expectations and disciplinary perspectives in each country's curriculum documents. Data have been analyzed using the two gigabit TIMSS data base in accordance with a comprehensive suite of newly designed statistical methods. This presentation will follow the main arguments of the first published report of this phase of TIMSS. Countries differ greatly in national visions and in educational systems, resources and aims. This presentation will discuss the contributions of this research to the questions of scientific literacy, summarize the shape of parity in TIMSS countries and discuss the question of whether parity of opportunity relates to patterns of similar outcomes in measures of student achievement.

Schoneweg, Cristine

Strand 3 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

Exploring Science Teacher Metaphorical Thinking: A Case Study of a Secondary School Science Teacher

Tom Dana

The paper reports on an in-depth case study of a beginning science teacher's metaphorical thinking about teaching, learning and its relationship to her teaching practice. Three in-depth, semi-structured interviews and field notes of observations of two science lessons were the primary data sources. The data were analysed through inductive analysis. The main findings about the participant's thinking and teaching were organized into seven themes. Among the main findings are the participant's dilemma in reconciling two role-metaphors, the "facilitator" and the "drill-sergeant" and her desire for more feedback to her teaching.

Schriver, Marti

Strand 6 — Tue, 25 Apr, 1995, 2:30 PM, Emerald

A Case Study of a Science and Mathematics Day Camp as Experienced by Six Girls from Rural Georgia

Lynn Wolfe W. Jay Strickland

This is a case study of a science and mathematics day camp collaboratively sponsored by the American Association of University Women, Georgia Southern University and a local Girl Scouts council. The camp was organized to promote positive attitudes toward mathematics and science, demonstrate the relevance of science and mathematics and provide women faculty in science and mathematics as positive role models for the participants. The camp was attended by 100 girls from a rural area of Georgia. This case study focused on one troop of six girls who will be entering Grade 1 in the Fall of 1994. Pre- and post- data were collected using a 24 item attitude instrument and a draw-a-scientist activity. The attitude questionnaire was adapted from an instrument developed by Fennema-Sherman (1976). In addition, during the camp, the girls were encouraged to keep a journal relating their activities and impressions. Preliminary results indicated positive changes in attitudes concerning science and in their views of women as scientists.

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Segal, Gilda

Strand 2 — Sun, 23 Apr, 1995 8:30 AM Oregon

Promoting Loud Thinking about Light in Elementary School Science

Mark Cosgrove

In studying young children learning in inclusive environments, we designed ways to enable children to explore scientific knowledge that is usually believed to require later, didactic teaching. Aspects of this design under scrutiny here are, first, the capacity of natural learning to lead to effective scientific ideas, and second, further clarification of the role of context. We found that in conversational modes, children were able to generate ideas and theories, to test them (by extended discussion in which they examined the logical consequences of holding those ideas and by subjecting them to critical tests), and then to generate further theories. In doing so, the role of analogical analysis was especially productive; the simile of moving objects bouncing from a surface helped the idea of light traveling to emerge naturally (a contrary finding to the belief that understanding the propagation of light should precede the study of reflection). In this environment children studied keenly and cooperatively, kept records and critiqued the topic. As a result of this learning our view on the ages at which children might begin to deal with scientific ideas have been revised downwards.

Settlage, John Jr

Strand 3 — Sun, 23 Apr, 1995 10:30 AM California

Natural Selection Conceptions Assessment: Development of the Two-tier Test "Understanding Biological Change"

A. Louis Odom

A two-tier test was developed for assessing secondary students' conception of evolution by natural selection. Items were developed around three central concepts: the role of variation within a population, the cause of the emergence of new traits and the effect of natural selection on the proportion of traits. The Understanding Biological Change test was given to high school biology students, refined and administered to another sample of students. The final version of the test consisting of fourteen items was administered in the spring of 1994 to 73 Biology students at two different suburban high schools in the Midwestern United States. The reliability of the test for this sample was 0.813 with difficult indices ranging from 0.18 to 0.55. Interpretation of the responses and suggestions for potential applications of the test to further research are described.

Sharp, Lynn

Strand 1 — Tue, 25 Apr, 1995 2:30 PM Nevada

Children's Figural and Operational Knowledge of Sound

Patricia F. Keig

To investigate the status of children's conceptual models regarding sound, think-aloud teaching interviews were administered to 32 Grade 5 students. Interviews probed concepts related to vibration, sound, travel, volume and pitch. Analysis distinguished the presence or absence of a concept of sound as motion and of the use of the word vibration. The coding system also captured the students' conceptions of sound as an entity in space and of sound propogation. The students' ability to discern differences in volume and pitch and the presence of figural or operational knowledge of means of altering them were investigated. Chi-square analyses were perfoimed for each observed outcome both by gender and by L1 or L2 learners. Student responses illustrating conceptual change as well as "tabula rasa" learning were present. Specific misconceptions revealed in the interviews are described. Although simple concepts were generally held for two of the aspects of sound, vibration and volume, accurate usable concepts and concept relationships for sound travel and pitch were not yet tightly held. A common difficulty in confusing variation in pitch with variation in volume (41%?? of students) is discussed in detail. In addition, there is evidence of the role of language in supporting or impeding the development of concept relationships. Further research into sound by educators is urged as a formative source of curriculum.

Shaw, Jerome M.

Strand 6 — Sun, 23 Apr, 1995 1:00 PM Oregon

Science Performance Assessment and Language Minority Students: Exploring the Interface

This study investigated the use of a performance assessment with 96 language minority students (LMS) in five high school science classes. Qualitative and quantitative data analyses showed that teachers and students had an overall favorable response to the assessment while English comprehension and expression skills were determining factors for certain items. The desire for more time was an issue for both students and teachers. While most student responses were reliably scored, the spelling and syntax of certain responses were significant sources of error. The degree of specificity of teachers' guidance also significantly affected students' scores. Recommendations from this study include increasing the clarity of an assessment's design, allowing LMS more time to complete assessments, and scoring responses with raters who are knowledgeable of typical patterns in written English by this student population. Furthermore, it is recommended that the use of performance assessments with language minority students be exploratory until such time as their validity and reliability with this population can be more adequately established.

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She, Hsiao-Ching

Strand 6 — Mon, 24 Apr, 1995 10:30 AM California

The Gender Equity in Students' Image of Science and Scientists

The purpose of this study was to examine any difference between boys' and girls' image of science and scientists at four different grade levels. The interview-about-instance (IAI) procedure with modified Boylan's 30 pairs illustrations and modified Draw-a-Scientist Test (DAST) two instruments were administered to the elementary school Grades 1, 3, 5 and middle school Grade 2 (Grade 8), total 297 students. Results of interviewing students with 30 pairs illustrations showed that lower grade level boys and girls made similar initial responses in relation to most of the 30 pairs illustrations and as students move into higher grade levels showed an increase in difference between boys and girls initial responses to the illustration, especially the appearance items. The DAST results showed the majority of the students drew male scientists, which number of male scientists been drawn are three times more than the number of female scientists. Girls drew female scientists about three times more often than boys did. In addition, both gender in Grade 5 drew more female scientists than any other grade levels. Moreover, more boys than girls drew scientists wearing glasses, facial features, symbols of research, technology and relevant captions.

Shepardson, Daniel P.

Strand 1 — Tue, 25 Apr, 1995 2:30 PM Nevada

Fourth Graders' Interpretive Frameworks for Understanding Electric Circuits

Elizabeth Moje

This investigation involved a case study of the nature of Grade 4 children's understandings of electric circuits and how their understandings provided them with frameworks for interpreting data derived from the observation and manipulation of electric circuits. The nature, consistency, detail and coherence of children's understandings influenced the power of their frameworks for interpreting electric circuit data. The study elucidates how children's interpretive frameworks of electric circuits allowed them to recognize data as anomalous or supportive of their understandings. Preliminary findings suggest the following emerging patterns: (1) children's interpretive frameworks of electric circuits are reflected in the detail, coherence and consistency of their understandings, (2) the consistency, coherence and detail of children's pre-instructional understandings revolved around either their understandings about electric circuit connections or their understandings about electric current and, (3) the consistency, coherence and detail of children's understandings about electric circuit connections and electric current influenced their interpretive frameworks, and thus, the degree to which their understandings were challenged and changed.

Sheppard, Judith

Strand 5 — Sun, 23 Apr, 1995 8:30 AM Emerald

The Effect of the Constructivist Approach in Science on Attitudes of Grade 3 Students: A Case Study of One School's Approach

The purpose of this study was to determine if a hands-on discovery approach to teaching science will produce a more positive approach toward science than an approach that is textbook-driven. An indirect purpose was to determine if there were gender related differences in the science attitudes. It was thought that Grade 3 students involved in a constructivist classroom would have more positive attitudes than those in a traditional classroom. Two surveys were administered to 70 Grade 3 students in three classrooms: the Questionnaire of teacher Interaction and Student Science Attitudes (Backe, 1993). Results found more positive science attitudes in the constructivist classroom than the traditional classroom. However, there wasn't a significant difference in these attitudes. Both boys and girls in all Grade 3 classrooms responded similarly to questions concerning attitudes toward science.

Sherman, Twyla G.

Strand 5 — Mon, 24 Apr, 1995 2:30 PM Portola

An Analysis of Student Outcomes Related to Integrated Science and Mathematics: An Applied Taxonomic Approach

Catherine Yeotis

This study is part of a three-part project designed to explore the nature of student outcomes related to participation in integrated science and mathematics activities in different cultural settings. Four teachers in Grades 4, 5 and 6 observed their students during integrated activities and recorded student outcomes and evidence in Classroom Observation Journals. The purpose of this study was to code, sort, and classify the student outcomes according to category, frequency, intensity, and source of evidence. A total of 313 student outcomes were generated. The outcomes were classified according to category (cognitive or affective), intensity (level of Bloom's taxonomy), frequency, process skill, and source of evidence. Two hundred 14 cognitive and 99 affective outcomes were identified, the preponderance of which reflect the lower levels in the taxonomies. Site 2 identified the highest proportion of cognitive outcomes and site 31 identified the highest proportion of affective outcomes. The process skills of observation, classification, measurement, and using numbers were most often identified. These results will be combined with those of another external researcher and further analyzed according to ethnicity to guide in the development of an integrated science and mathematics assessment package that is culturally sensitive and responsive.

Sherwood, Robert D.

Strand 7 — Tue, 25 Apr, 1995 2:30 PM Portola

The Scientists in Action Series: Scientific Inquiry for Authentic Learning Environments

Xiaodong Lin

The purpose of this presentation is to discuss some of the issues related to development and use of a constructivist model of instruction that we call "Anchored Instruction" in science instruction. We will do this by: (1) discussing some of the theoretical issues that have lead the group to this still evolving theory of learning and instruction, (2) providing an example of the theory through the *Scientists In Action* project, that has used the design principles resolved from the theoretical framework, (3) describing and summarising some of the pilot research studies, and (4) suggesting possible classroom applications.

Shokere, Luke

Strand 10 — Tue, 25 Apr, 1995 8:30 AM Monterey

Alternative Research Methods: Comparative Pedagogical Profiles and Truth Tables

Interpretive researchers are encouraged to use the full repertoire of methodologies at their avail - either existing or created (Interpretive Research in Science Education 1991 p. 249-71). In a dissertation directed at understanding the phenomena of how teachers come to self-differentiate into either users or nonusers of curriculum innovations, a methodology that involved the use of hypothetical truth tables was applied. Attendant with this methodology, a unique characterisation of teachers called "pedagogical profiles" was devised. These approaches to data analysis were observed to be informative for rendering a concise description of the process from the voluminous data corpus, as well as, indicating generic "types" of science teachers that can be abstracted to other situations. A critique of this approach to data analysis is invited.

Shroyer, Gail

Strand 3 — Sun, 23 Apr, 1995 10:30 AM Washington

Expertise in Preservice Science Education: An Innovative Approach to Training Elementary Science Educators

Emmett Wright

According to many of the reports, undergraduate teacher preparation programs are the key to reform in science, mathematics and technology education at both the elementary school and the secondary school levels. During the fall semester of 1990 Kansas State University initiated the development of a major university-wide model, supported in part by a grant from the National Science Foundation to reform elementary school mathematics, science and technology preparation based on the above recommendations. A major focus of the project is the creation of a partnership between the College of Arts and Sciences, the College of Education and the Manhattan-Ogden Public Schools, according to guidelines established by the Holmes Group (1986, 1989, 1990), the Carnegie Forum (1986) and Goodlad (1990). Three professional development schools were created in the public school system as an outcome of this collaborative effort. Preliminary data indicate that these teachers are superior to other graduates especially in science and mathematics.

Shymansky, James A.

Strand 5 — Sat, 22 Apr, 1995 8:30 PM Emerald

A Strategy for Assessing Changes in Teachers Participating in an Enhancement Project

Margaret Jorgensen **Jennifer Chidsey John** **Thomas Koballa** **Deborah Dunkhase**
Laura Henriques **Ibrahim Al-Momani** **Eric Olson** **Courtney Veronesi**

This paper describes the development of an assessment system to document change in teachers' science understandings and attitudes towards science as a result of a special enhancement program called the Science PALs project. Science PALs is an incremental and systemic program to enhance the science background of elementary teachers by using science-based stories and language activities to engage teachers and students in more hands-on science. The use of students' science ideas establishes a relevant problem-centered context in which elementary school teachers are willing to commit effort to address students' science learning and in so doing enhance their own science background. The challenge was to develop an assessment system that is consistent with constructivist philosophy and that informs both the participants and the staff about change in science understandings. These goals have been accomplished by implementing a portfolio assessment system that documents six dimensions of teacher behaviors. Scoring rubrics, exemplars and data from Phase 1 of Science PALs are reported.

Simmons, Patricia

Strand 5 — Mon, 24 Apr, 1995 4:00 PM Oregon

Pedagogical Philosophies: A Study of Inservice and Preservice Science Teachers

Lon Richardson

This session is intended to: provide a forum for interactive dialogue featuring diverse research perspectives on the views of preservice and inservice teachers about their teaching philosophy, epistemology and curriculum implementation; provide an opportunity for participants to reflect on and discuss the different views of the teachers by examining profiles of selected cases; discuss current research perspectives from which to interpret and synthesize the findings and implications of this research in relation to science education research; synthesize and discuss implications of these kinds of research studies for teachers and students on an individual basis, a classroom basis and an institutional basis.

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Slater, Timothy F.

Strand 5 — Sun, 23 Apr, 1995 10:30 AM Suite 2625

A Qualitative and Quantitative Comparison of the Impact of Portfolio Assessment Procedures versus Traditional Assessment in a College Physics Course

Sara L. Samson Joseph M. Ryan

Popular belief in alternative assessment procedures suggests that the use of student portfolios can help learners successfully organize and integrate newly acquired scientific knowledge and provide useful assessment information. This study documents the use of student created portfolios in an algebra-based, college-level, introductory physics course using a two-group comparison design. One group was assessed by traditional, student-supplied, short answer examinations. The other group used portfolio-style assessments except for the final examination. A cumulative, identical, multiple-choice final examination was administered to both groups. There was no significant difference in learner achievement between the two groups on the final examination. Furthermore, a self-report of achievement given before and after the course demonstrated no significant difference between the two groups. Analysis of an open-ended survey and a focus group discussion, however, did suggest that students assessed by portfolios devote considerable time to reading and studying, internalize and personalize the content material and enjoy the learning experience. The results of this study suggest that the use of portfolio-style assessments support student achievement at the same level as traditional assessment procedures and might have additional benefits.

Smith, Edward L.

Strand 5 — Tue, 25 Apr, 1995 2:30 PM California

The Design and Rationale of the New Michigan Educational Assessment Program in Science

This paper describes several important features of the new Michigan Educational Assessment Program for science and the rationale for those features. The new science assessment is based on a recently adopted state science curriculum framework which, in turn is based in part on *Science for All Americans*. The assessment is being developed to service three purposes: to provide information about student understanding of science, to model sound classroom assessment and instructional practice and to promote teaching for understanding over innovative problem types including cluster problems (5-6 questions about a real world context), text criticisms (5-6 questions around a text passage) and investigation clusters (5-6 questions around an investigation that the students carry out ahead of time); two-part tests including a Framework — Wide Assessment assessing a representative sample of all objectives from the framework and an Area-specific Assessment which is a more concentrated assessment of a small set of related objectives; and the use of constructed response as well as multiple choice items.

Smith, Mike U.

Strand 8 — Tue, 25 Apr, 1995 2:30 PM Crystal

Believing, Knowing and Accepting: Epistemology in Science, Religion and the Science Classroom

Stanley Obitts William W. Cobern John A. Moore Denis Phillips

Almost half of US high school Science teachers support the teaching of creationism in public schools and almost half of college students evaluate the evidence supporting astrology as "good" or better. We believe that two of the primary reasons for this confusion are the lack of understanding of the differences between the epistemologies of science and non-science fields such as religion and the failure of all parties to recognize the fact that terms used by individuals from diverse disciplines often have meanings that are different in subtle but important ways that confuse communication. Presenters in this symposium from Biology, Science Education, Philosophy and the theology will identify the epistemological, philosophical and semantic issues involved, focusing on the divergent meanings of the terms *believe, know, accept, prove, fact* and *theory*. The purpose of the symposium is not to repeat old debates but to explicitly display the underlying philosophical differences in how scientists and non-scientists come to know.

Smith, R. Timothy

Strand 5 — Sun, 23 Apr, 1995 10:30 AM Suite 2625

An Analysis of the Portrayal of Scientific Explanation in Elementary School Science Textbooks

Building upon the curriculum evaluation model of *conceptual analysis*, this study integrated criteria for authentic, causal, *scientific explanations* with successful constructivist instructional strategies. The result was a set of six "focal concerns" used to analyze and represent the portrayal of the nature of science in several widely used elementary school science textbooks (for Grades 4, 5 and 6) by evaluating their explanatory quality. Using weather phenomena (e.g. the causes of wind) as the subject matter context, the paper discusses findings related to each of the six "focal concerns": (1) *accuracy*, (2) *thoroughness*, (3) precise formulation of *language*, (4) explanatory *justification*, (5) *scale* of the phenomena considered and, (6) opportunities for modeling and practising explanation *generation*. In turn, implications of these findings are discussed in light of recent concerns with and research into both teachers' and students' conceptions of the nature of science.

Sode, John R.

Strand 4 — Mon, 24 Apr, 1995 8:30 AM Suite 2601

Longitudinal Patterns of Beginning Science Teachers' Stages of Concern Laboratory Usage

The first objective of this study was to examine beginning science teachers' stages of concern (SoC) over time. These SoC's were compared to those of more experienced, professionally active science teachers. The second objective was to determine beginning science teachers' laboratory usage patterns. These patterns were compared to those of more experienced, professionally active science teachers. Data were collected through a series of mailed and hand-distributed surveys over a period of three years. Additional questions were added to follow-up surveys to obtain insight into issues raised in previous years. Comparison frequency distribution tables were constructed to identify trends and patters in SoC distributions and laboratory usage rates. The most prevalent beginning teacher SoC was Stage Four (consequences). Stage Four dominance was consistent over time. More experienced, professionally active science teachers were characterized by a shift towards Stage Five (collaboration). Beginning science teacher laboratory usage rates were similar to those of more experienced, professionally active teachers. The more experienced, professionally active science teachers reported the highest mean laboratory usage rate and advocated the greatest use of laboratories.

Soloway, Elliot

Strand 7 — Sun, 23 Apr, 1995 10:30 AM Gold Rush B

ScienceWare: Rationale and Context

Joe Krajcik **Liza Finkel**

The ScienceWare Project is providing an integrated suite of computer-based tools that can support high school students engaging in the full range of science modeling activities. Three interacting themes guide this work: Science: Modeling —Our effort is directed at supporting students in developing the process and content knowledge that is needed to develop scientifically—defensible, intellectually-provocative models. Pedagogy: Project-Based Science (PBS) —In PBS students are engaged in inquiry over extended periods of time exploring a driving question; they draw on scientific disciplines as needed, work collaboratively, employ technology routinely and construct all manner of artifacts. Technology: Learner-centered Design —Ease of use is no longer the only goal; rather, addressing the special needs of learners - their diversity, their wavering motivation, their initial lack of understanding and the subsequent growth in their understanding—is coming to be seen as the new challenge. The ScienceWare Project is a multi-disciplinary, collaborative effort involving the College of Engineering/UM, the School of Education/UM, Community High School in Ann Arbor, the Green Project, Northwestern University. In 1993-94, there were 22 students at Community High School using the ScienceWare suite; in 1994-95, there are 122.

Spiegel, Sam

Strand 4 — Sat, 22 Apr, 1995 7:00 PM Oregon

Teachers' Struggle to Articulate Their Learning Theories: A Window into Teaching and Learning

Angelo Collins

As part of a Master's level Teaching and Learning course, 66 teachers were required to describe their personal learning theory and provide an illustrative vignette from their classroom practice. The teachers drafted their theory and then critically reviewed each others. The process of peer review proved to be an uncommon window to examine the culture of teaching as well as the cognitive process of the teachers. This study examines these aspects and explores the implications of this activity. Data consisted of the teachers' draft and final learning theory papers, observation of the peer review process and reflective conversations with several of the teachers. The papers were reviewed and coded by both researchers. Coding was based on phrases that indicated either cultural, i.e., "uncommon practice at our school" or cognitive, i.e., "lead me to a new understanding", insight. Observations and editing comments from the peer review process were coded similarly. Results indicate clusters that correspond with particular modes of teacher education, i.e. learning cycle.

Spiller, Richard

Strand 2 — Sun, 23 Apr, 1995 8:30 AM Emerald

Investigating the Origins of Teachers' Attitudes Toward Teaching Elementary Science

Pierce Farragher

This project investigated the origins of teachers' attitudes towards teaching elementary science. The study was divided into a quantitative and a qualitative section. The quantitative part asked intermediate teachers to complete an attitude scale and provide various demographic data. Statistical analyses included; means, frequencies, Pearson correlation coefficients, reliabilities, factor analysis and t-tests. The qualitative part consisted of six interviews. Interviews examined; understanding of science, childhood experiences, influential people, world events, an assessment of subjects' attitude to science and science teaching and their perceived inservice needs. Results showed that while the overall attitude towards science was good in the district studies, there was considerable frustration over the actual teaching of science. Only teachers who had taken chemistry or physics in high school had significantly positive correlations with attitude towards science and the teaching of science. Gender differences were only significant on the comfort/discomfort subscale. Origins of attitudes stemmed from environmental sources, i.e. home, cultural and economic times in which they lived. Parents and families were most influential, with individual personalities playing a role in attitude development. Also important were the psychology, sociology and scientific developments of the society in which they lived.

Spitulnik, Jeff

Strand 7 — Sun, 23 Apr, 1995 10:30 AM Gold Rush B

Interactive Media Literacy in the Foundations of Science Classroom

In project-based, computing-enhanced science learning classrooms, a plethora of interesting computational media artifacts are produced that give insight into the processes, influences and understandings occurring in the classroom and in the students' lives. Examination of the socially organized practices which make use of symbol systems and technologies for producing these communicative artifacts enables and understanding of the literacy practices in this setting. By investigating the literacy in the Foundations 1 classroom, this case study reveals the processes and symbol systems; the social, political and cultural influences; and some consequences of the artifact production. The study focuses on one group of four girls who were videotaped and interviewed during and after they designed and constructed a computer-based multimedia museum exhibit for a class assignment. The group produced an impressive array of materials, exhibiting complex cognitive and social processes concerning science content, communication and the use of computer-based tools. The students were influenced by a range of social and technological, intrinsic and extrinsic factors such as their attitudes toward technology, the design of the tools and the structure of the assignment. They also altered their understandings and attitudes about communication, science and group processes.

Spitulnik, Michele W.

Strand 7 — Sun, 23 Apr, 1995 1:00 PM Portola

Students Modeling Concepts and Conceptions

The use of hypermedia technology in science classrooms has great potential for enhancing knowledge construction and conceptual understanding. The theoretical rationale for students designing and constructing instructional hypermedia artifacts in chemistry classrooms is examined with a focus on constructing multiple representations of concepts, developing connections between multiple representations and creating models or animations of phenomena. Ninety high school Chemistry students in the 1993-1994 school year constructed hypermedia artifacts on kinetic molecular theory. Versions of the hypermedia constructions, or artifacts, were analyzed to determine the nature of the representations, animations or models the students constructed, the appropriateness of these representations for the concepts and the connections students made between representations. The paper describes these areas in relation to: (1) students' conceptual understanding and, (2) students developing conceptual understanding as they evaluate and revise their artifacts. Findings indicate that in later versions, students use more representations like animations and graphs, draw more explicit connections between representations and have fewer conflicting representations. Student design, modeling and construction of hypermedia artifacts appears to be an effective method of developing robust conceptual understanding.

Stark, Rae

Strand 5 — Tue, 25 Apr, 1995 2:30 PM California

Implementing a National Curriculum in Elementary Education: Issues and Implications

The move towards establishing a national curriculum for the learning and teaching of science is gaining pace in many countries. In Scotland, as elsewhere, the policy statements tend to promote a view of science as primarily an investigative activity which requires the integration of conceptual understanding, practical and process skills. If the curriculum which children experience is to reflect this view, the nature of the learning and assessment experiences offered to individuals and groups (e.g. boys/girls) must be designed to ensure equity of opportunity. In considering these issues, this paper draws on the findings of the Scottish Assessment of Achievement Programme's Science survey. The data, primarily obtained to present a national picture of achievement at three stages — 8/9 years, 11/12 years and 13/14 years — has been analysed to identify differences in performance levels by sex, across sub-skills and within age cohorts. Thus some of the factors to which teachers will have to attend e.g. the balance of practical and written work, equity of opportunity and differentiation of provision, will be examined.

Stoddart, Trish

Strand 6 — Tue, 25 Apr, 1995 8:30 AM Suite 2601

Enhancing the Performance of Hispanic Students: The AVANCE Project in the High School

Thomas Destino

During the 1993-4 academic year, the University of California, Santa Cruz and a high school participated on a collaborative research and development project to formulate a model strategy for improving the academic performance of limited English proficient (LEP) Hispanic students. The site for the program was at a school whose LEP Hispanic student population surpasses 16% of the school's total enrolment (1333 students). The project's theoretical and empirical foundations in cognitive science, language development and effective schooling suggests that the academic competence of typically underserved minority students can be enhanced significantly through instructional strategies that emphasize cooperative learning, heterogeneous skill groupings, higher course standards, student-generated themes and staff networking. The program maximized academic learning by integrating instruction in ESL, Spanish, Social Studies, Science and Mathematics and utilizing appropriate programming, while de-emphasizing ability tracking. Analysis of the implementation, including interviews with teachers and students, will be discussed.

Stratford, Steve

Strand 7 — Sun, 23 Apr, 1995 10:30 AM Gold Rush B

Impact of ScienceWare and Foundations on Students' Attitudes

Liza Finkel

In this paper, we describe changes in students' ideas about Science classes, attitudes about Science and motivations for studying Science, in a classroom designed to support project-based Science learning. Using a survey designed to provide a measure of students' attitudes towards Science classes and Science, we have compared students enrolled in a traditional high school biology course, with students enrolled in the integrated, project-based science course called Foundations 1. Survey responses were analysed to look at differences between the two groups of students and to look at differences within the groups of students. In general, the results of this study suggest that providing students with opportunities to collect and analyze their own data in Science classes results in a change in students' ideas about science classrooms. Foundations 1 students increased tendency to agree with statements about "using information", "drawing conclusions" and "thinking about problems", implies a change in their understanding of what it means to do science in school. These students, in contrast to students in the traditional Biology course, no longer describe their science experience as one of memorisation, textbook reading and test taking. Instead they see science class as a place in which they can collect data, draw conclusions and formulate and solve problems.

Streveler, Ruth

Strand 1 — Tue, 25 Apr, 1995 1:00 PM Emerald

Conceptual Change in High School Chemistry: A Multidimensional Scaling Approach

This paper presents a method for using multidimensional scaling to compare the cognitive structures of high school chemistry students to the cognitive structure of their teacher. Inconsistencies between the teacher's and students' structures may represent possible areas of misconception. A high school Chemistry teacher identified terms he felt were important for students in his class to learn. He grouped the terms and described why each group of terms belonged together. At the beginning and end of a semester, 50 high school students in the teacher's Chemistry class grouped the same terms and explained why each group belonged together. The students' groupings were analyzed using multidimensional scaling and were compared to the teacher's groupings using nearest neighbor analysis and geometric proximity of the terms to the group centroid. Pre-test and post-test comparisons of students' groupings were made, as well as comparisons between the post-test and groupings of high- and low-achieving students. Analysis of the multidimensional plots revealed differences in pre-test and post-test groupings and in the groupings of high-versus low-achieving students. The theoretical and educational implications of these differences are discussed.

Stubbs, Harriett

Strand 4 — Mon, 24 Apr, 1995 4:00 PM Suite 2625

A Constructivist Model of Professional Development for Science Teachers

Ann C. Howe

A constructivist approach to the professional development of science teachers must involve teachers in the construction of their own knowledge about science and about science teaching since it is difficulty for teachers to adopt a constructivist approach in their own teaching if they have not had the experience themselves. The model presented in this paper, which follows Fosnot's four principles of constructivism, was developed as a means of enabling middle school and high school teachers to include environmental issues in their science curricula, but it would be applicable to a wide range of curriculum areas and needs. The model builds on teachers' existing knowledge and experience as new information and new ideas are presented by scientists and others. The personal and professional interactions between teachers and between teachers and scientists lead to cognitive conflict and resolution, reflection and finally, teachers' construction of new knowledge for themselves and the creation of curriculum materials for their students. Surveys, focus groups and individual interviews, have been used to document the outcomes. These include an increase in participation in professional meetings and activities, renewed enthusiasm for teaching and other indicators of professional growth.

Stuessy, Carol L.

Strand 3 — Tue, 25 Apr, 1995 8:30 AM Gold Rush A

TARPS III: Implications of the TARPS Model for Balancing Content and Process in Integrated Contexts

Kim Dooley

Current problem solving curricula designed for the integration of mathematics and science range from those that stress the acquisition of subject-matter knowledge in one discipline with support from another to those that subjugate subject-matter knowledge in both domains to higher-level problem solving. The TARPS model is one that attempts to integrate both knowledge domains within a framework that balances content and problem solving process. Concerns of balance were solved early in the development of the model by identifying many scientific and mathematical processes as domain-specific strategies and translating scientific and mathematical "content" into a hierarchy of themes (e.g. Structure, Interaction, System) that ranged from lower to higher levels of complexity. Questions for this research centered on teachers' perceptions of the importance of balance in their lessons and how well they understood and used the model in their lesson planning. Data collected from 26 teachers in the project indicated changes in teachers' conceptualisations of the inclusion of mathematics and science content and overall problem solving processes in their lesson planning. Barriers and difficulties in using the model were identified and follow-up intervention strategies were designed and implemented with varied success.

Suarez-Gómez, Alfonso

Strand 9 — Sun, 23 Apr, 1995 1:00 PM Washington

Constructivismo y Condicionamiento en los Procesos de Ensenanza y Aprendizaje de las Ciencias

Durante mi trabajo de investigación tanto con docentes como con estudiantes, he encontrado que uno de los principales problemas para poder cambiar de la metodología tradicional a una metodología constructivista, son los preconceptos tanto de los profesores como de los estudiantes, sobre lo que deben ser los procesos de enseñenza y aprendizaje. En los primeros, aún en muchos casos de algunos que se autodenominan constructivistas, se encuentra que la fuerza del condicionamiento efectuado sobre ellos durante muchos años de educación los hace trabajar con una mezcla de las dos tendencias que qunque representa un avance, a veces llega a confundirlos tanto a ellos como a sus estudiantes. En los estudiantes por tanto tenemos que tener en cuenta no solo los preconceptos sobre el tema a aprender, sino también como ya dijimos los preconceptos sobre lo que ellos piensan que deben ser los procesos de enseñanza y aprendizaje. Después de varios años de trabajar en los probelmas de enseñanza y aprendizaje y su relación con los problems humanos, he encontrado que estos preconceptos se han convertido en factores condicionantes del posterior desarrollo del individuo en aspectos tan importantes como el aprender, el pensar y el actuar, y una alternativa de solución muy prometedora es su identificación y toma de conceiencia de los mismos y del efecto quef tiene lo que pensamos sobre nuestro desarrollo y con el sobre el desarrollo de la sociedad.

Sullivan, Sherry

Strand 4 — Sun, 23 Apr, 1995 1:00 PM California

Elementary Science Teaching and the Culture of Schooling: Dilemmas Facing Preservice Teachers

The purpose of this study was to investigate possible issues and factors of teacher preparation which hinder, or facilitate prospective elementary teachers' implementation of science teaching practices consistent with their understandings of the nature of science. A naturalistic study of 16 participants in an elementary science methods classroom was conducted. Participant observation, videotaping of classes, interviews with participants and analysis of written documents were used to gather data. Results indicate that background content knowledge, teacher socialisation issues and academic issues related to preservice teachers as college students have an important impact on prospective teachers' science teaching practices. Even students with good understanding of the nature of science were hindered by unsupportive field placements, lack of adequate content knowledge and the perceived pressure of evaluation by co-operating teachers.

Sunal, Dennis W.

Strand 3 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

Determining and Comparing the Alternative Conceptions of the Concept of Force of Non-science Education Majors and Practicing Teachers Using the Interview-about-Instance Technique

Linda Ewing

The purpose of the investigation was to determine and compare the scientific literacy of two groups of teachers by probing and analyzing their knowledge related to the concept of force in aerospace science events. Using the interview-about-instances technique, three categories of conceptions were analyzed including: (1) aspects of the concepts of force undetected by the participants, (2) invalid uses or alternative concepts and, (3) sources of linguistic confusion. Two groups were interviewed. The interviews were audiotaped and transcribed for later analysis. One group was preservice elementary teachers completing a course designed to address their prior knowledge and alternative conceptions about aerospace science concepts. The second group was inservice elementary teachers from five local area districts to which the preservice teachers will be assigned for clinical experiences over the next two years. Using established methods of coding and analysis significant differences were found between the preservice and inservice teachers interviewed. The data indicated a pattern of the deletion of several aspects of the concept to force in events related to the solar system, weather and aerodynamics. The scientific literacy of preservice teachers related to the concept of force was enhanced to a level required for effective teaching.

Sunbury, Susan E.

Strand 10 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

The Educational Impact of an Overnight Museum Experience

The educational impact of an overnight science program conducted at the Boston Museum of Science for Girl Scouts and Brownies was evaluated. The extent to which the girls exhibited curious behavior during the program and became more curious about science following the program was assessed using an observation checklist, a participant questionnaire and a Likert-type Science Curiosity Scale before and after the intervention. The degree to which the program positively altered perceptions of scientists was assessed using the Draw-a-Scientist test administered in pre- and post-intervention fashion. Cognitive gains made by the participants were assessed using concept development tasks. The long-term impact of the program was determined from interviews of past participants. Curious behavior was observed and self-reported by the participants during the program. Because of an instrumental Hawthorne effect, conclusions regarding post-interventional changes in scientific curiosity could not be drawn from the Science Curiosity Scale data. Changes in participants' perceptions of scientists were seen on the Draw-a-Scientist Test. Analysis revealed that significant cognitive gains were also made by the campers. Past participants of the program have remained interested in science, the majority have returned to the museum with family and friends.

Suzuki, Mariko

Strand 1 — Tue, 25 Apr, 1995, 8:30 AM, Oregon

A Study about Naive Concepts of the Solar System Based on Investigation of Junior High School Students by Questionnaire Method

Yuhei Yamauchi Katsuo Sugai

It was reported that understanding of the movement of the planets, which had been learned in the second area of junior high school science in Japan was difficult. The purpose of this study was to investigate how Japanese children at a junior high school think about the solar system by questionnaire method and to make clear the features of their ideas. It was found that students had naive concepts of the solar system. These concepts were categorized into three naive models. Model 1: the two-dimensional solar system and the observer focusing on the relative velocity. Model 2: the two-dimensional solar system and the observer viewing from another point in the universe. Model 3: the two-dimensional solar system and the observer viewing from the three-dimensional Earth. Two features of these naive concepts were found: (1) naive observers think of the solar system in terms of two-dimensions rather than three and, (2) naive observers do not know where they are in relation to the objects they are viewing.

Svec, Michael T.

Strand 7 — Sun, 23 Apr, 1995, 1:00 PM, Portola

Effect of a Microcomputer Based Lab on Graphing Interpretation Skill and Understanding of Motion

The purpose of this study is to examine the relative effectiveness of the traditional lab method and the microcomputer-based laboratory (MBL) for engendering conceptual change in students. Three areas of achievement were examined: graphing interpretation skills, interpreting motion graphs and conceptual understanding of motion. The nonequivalent control-group design was selected with the treatment group conducting using MBL activities and the control group employing traditional laboratories. All the students were enrolled in introductory college physics classes. Item analysis revealed both control and treatment groups confused position, velocity, acceleration and distance, velocity and acceleration-time graphs on the pre-test. On the post, the the control group scores improved only slightly. The treatment group demonstrated a less thorough understanding then the control on the pre-test, but the treatment group outperformed the control group on the post-test. Effect sizes were 0.78, 1.71 and 0.88 for graphing interpretation skills, interpreting motion graphs and conceptual understanding of motion respectfully. Results indicate that MBL laboratories are more effective than traditional lab for improving students' graphing interpretation skills, interpreting motion graphs and their conceptual understanding of motion. MBL is an effective tool for challenging students' naive beliefs.

Talsma, Valerie L.

Strand 5 — Mon, 24 Apr, 1995, 8:30 AM, Gold Rush B

The Interactive Rouge River Water Quality Monitoring Program: An Evaluation of an Environmental Education Program

The Rouge River Project, a secondary school based interdisciplinary environmental education program in Metro-Detroit involving water quality monitoring, telecommunications and student actions, was evaluated in 1991 during its fifth programmatic year. Participating teachers were surveyed for level of participation, goals and objectives of participation, use and value of provided support services and changes in teaching methodology and environmental awareness resulting from participation in the program. The surveys were followed by focused interviews and a debriefing session at the program closure. The three sources of information were cross analyzed for patterns and answers to the guiding questions. Student pre/post-tests assessing knowledge, attitudes and skills were included in the evaluation. Analysis indicated that this program is meeting its goals of increasing awareness and concern about the Rouge River and developing a supporting curriculum in the science classrooms. The student data indicate positive changes in student knowledge of the Route River and associated environmental issues with evidence of longer term attitudinal changes in participants. Recommendations to FOTR for improving this program include: (1) improved tracking of participation, (2) refined teacher training sessions, (3) increased support of telecommunications, (4) more interdisciplinary emphasis and, (5) continuing program evaluation.

Tamir, Pinchas

Strand 5 — Sun, 23 Apr, 1995, 1:00 PM, Redwood

Teachers' Involvement in Balanced Assessment in Israel

External, on-demand assessment, occupies a unique status in schools. Many teachers, all over the world, conceive it as a burden, as an unpleasant experience that "steals" precious time from student learning. However, assessment can be a positive experience for both students and teachers. In fact, it is possible to improve and upgrade learning and teaching through the design and use of assessment in a variety of ways. The main thesis of this paper is that it is desirable and possible to make a better use of assessment and that balanced assessment can be an excellent means for upgrading teaching and learning. The paper will describe the role of Biology teachers in the matriculation test for high school graduates in Israel. The Biology matriculation course in Israel is similar in its curricular coverage to the AP Biology in the United States, but the final assessment at the end of the course is completely different. The assessment is a balanced combination of short-answer items, lab experimentation, research analysis and a year-long individual project in ecology. The presentation will focus on the various roles of the Biology teachers (e.g. instructor, research supervisor and evaluator) during the Biology matriculation course and will specify the contribution of the teachers in the different parts of the balanced assessment (paper and pencil, lab practical and long-term ecological projects).

Taylor, Marilyn

Strand 4 — Sun, 23 Apr, 1995, 4:00 PM, Washington

Diversity Reforms in the Rocky Mountain Teacher Education Collaborative

Kathryn Cochran

This paper describes the five year goals and the first year accomplishments in the diversity initiative of the Rocky Mountain Teacher Education Collaborative. The component of RMTEC is focused on developing new systems and coordinating existing systems for recruitment and retention of minorities and women pursuing middle or secondary education in science and mathematics. Project faculty within and across the institutions are being offered staff development opportunities to promote culture and gender sensitive instructional practices. Diversity actions groups have been created at each institution to provide direction for this component and to assure that this initiative is directly integrated with the other reform components.

Taylor, Peter C.

Strand 2 — Mon, 24 Apr, 1995, 2:30 PM, Redwood

A Constructivist Perspective on Monitoring Classroom Learning Environments under Transformation

Barry Fraser — Vaille Dawson

At NARST in 1994, we presented a revised version of our new Constructivist Learning Environment Survey (CLES) designed to enable teacher-researchers to monitor their development of constructivist approaches to teaching school science and mathematics. Our ongoing research program had revealed major socio-cultural restraints (e.g. teachers acting in accordance with repressive cultural myths of cold reason and hard control) to the development of constructivist learning environments. By incorporating a critical theory perspective on the socio-cultural framework of the classroom learning environment, we hoped that the revised CLES would empower teachers to address these constraints. The purpose of this paper is to present the results of two collaborative action research studies in high school science and mathematics classrooms that examined the viability of the new CLES scales. The results provide unique insights into classroom environments under transformation, especially from a constructivist perspective and raise important issues about the use of learning environment surveys to stimulate and monitor the process of transformation.

Taylor, Peter C.

Strand 8 — Mon, 24 Apr, 1995, 4:00 PM, Gold Rush A

Interpretive Research: A Vehicle for Social Reform

Loren White — Mark Campbell-Williams

The aim of this symposium is to generate insights into the complexities and prospects of employing interpretive research as a referent for classroom-based research in science, mathematics and computing classrooms. The panelists will share their experiences of going beyond the traditional role of interpretive research as an epistemology for generating hermeneutic understanding within the social setting of the classroom. They will illustrate how they are combining interpretive inquiry with theories of social reform to generate powerful frameworks which have potential for restructuring the culture of education. However, these classroom-based research programs are not without their problems. The gap between "what is" and "what should be" can become disturbingly large for critically reflective teachers. The emancipatory interest can be a two-edged sword that renders teachers as victims of zealous teacher researcher reform programs. The multiple roles of teacher, researcher and reformer sometimes conflict when they generate competing priorities. The rigour of interpreting the well-spring of our unconscious knowledge has yet to be established. These are some of the challenges that will be explored with participants during the symposium.

Thiele, Rodney B.

Strand 1 — Sun, 23 Apr, 1995, 2:45 PM, Gold Rush B

Analogy Maps: Determinants of Conceptual Understandings?

This study investigated high school chemistry students' use of textbook analogies. Survey instruments referred to as Analogy Maps were provided to 27 Grade 11 Chemistry students to determine whether they were able to draw appropriate mappings from the analogy to the target concept. Secondary analysis allowed the researcher to investigate whether the Analogy Maps might also be used to determine if students held correct or incorrect conceptions of abstract chemical concepts such as atomic structure and the mole concept. Students attempted a range of mappings, many of which were inappropriate. Rather than change their conceptions of the target concept, students often reconstructed their mental image of the analogy based upon their own experience to make it fit the target. Although the analogy maps were useful as a means to identify alternative conceptions, there was evidence that the analogies contained therein did not sufficiently challenge the status of these alternative conceptions so as to result in their replacement with more scientifically valid conceptions. There was little evidence that the analogy maps contributed to the formation of alternative conceptions in the learners.

Thomas, Jeff A.

Strand 5 — Sun, 23 Apr, 1995 7:00 PM Exploratorium

The Development, Field Test and Validation of a Wetland Ecology Test

Rosalina V. Hairston

Two versions of a wetland ecology test were developed to measure cognitive gain in teacher and student knowledge of ecological concepts in freshwater wetland ecology. Test items were pooled from a standardized test in Biology, chapter tests from texts commonly used by teachers and items contributed by teachers. The following content categories were selected based on topics in Aquatic Ecology listed in the Mississippi Science Curriculum, namely; food chains, food webs, pollution, population ecology, water quality and ecological succession. Bloom's taxonomy was used to classify the cognitive categories of the items. The tests were field tested to comparable populations of teachers and students. Reliability of the tests were 0.88, determined using Kuder-Richardson. Content validity, face validity and construct validity were verified by a panel of experienced teachers. The tests measure both content and cognitive skills in Aquatic Biology.

Thomas, Julie

Strand 4 — Sun, 23 Apr, 1995 8:30 AM Emerald

Reform in Elementary Science Education: A Critical Ethnography

The critical ethnography presents a cultural portrait of four suburban, elementary teachers involved in the NSF funded State Systemic Initiative to effect change in science and mathematics education. A consideration of resistance theory guided the observations, interviews and on-going dialog with these teachers about their understanding of how and why their teaching is similar to or different traditional teaching. Research results indicate that science is a priority and a dynamic component in these classrooms. Science lessons are creative, motivational, inquiry based and highly interactive. Resistance to change or power issues were not experienced by these teachers except as they came to know the limitations of the administration in regards to their increased need to network with other teachers.

Thomas, Ray

Strand 4 — Mon, 24 Apr, 1995 4:00 PM California

Follow-up Evaluation of Argonne National Laboratory's Teacher Enhancement Program and Educational Outreach Vehicle

Paul Tuss Randy Landsburgh

This evaluation explores the effectiveness of an enhancement program for precollege teachers conducted by Argonne National Laboratory. Intended to promote the use of sophisticated scientific research tools in precollege science courses, this program involved two main components: (1) training teachers in the operation and application of cutting edge research equipment, and (2) establishing a mechanism by which teachers could borrow the research equipment for use in their classroom. The effectiveness of the program was evaluated using survey and focus group methodologies. Over 6700 students in Chicago area schools were exposed to the advanced loan equipment through the Instructional Outreach Vehicle. Teachers rated the equipment loan program on a number of items using a Likert scale. The most positive ratings were given for items addressing the overall value, students' knowledge and skills and teachers' enthusiasm. The least positive rating was for the item, *I found it easy to fit the equipment into my curriculum*. One aspect of the teacher institute clearly stood out when teachers discussed the most valuable aspects of the program—the opportunity to learn how to operate and bring into the classroom sophisticated research equipment.

Thoresen, Carol W.

Strand 3 — Sun, 23 Apr, 1995 8:30 AM Carmel

Implementation of Inquiry-based Tutorials in an Introductory Physics Course: The Role of the Graduate Teaching Assistant

The purpose of this study was to determine if the training provided physics teaching assistants was sufficient to accomplish the objectives of *inquiry-based* tutorials for an introductory physics course. Qualitative research methods were used: (1) to determine if the *Physics by Inquiry* method was modeled, (2) to describe the process from the teaching assistant perspective, (3) to determine TA opinions on training methods and, (4) to develop a frame of reference to better understand the role of TA's as instructional support staff. The study determined that the teaching assistants verbalised appropriate instructional actions, but were observed to use a predominantly didactic teaching style. They felt comfortable in the role of tutorial instructor. They were satisfied with the training methods provided and had few suggestions to change or improve training for future tutorial instructors. TA's held a variety of perceptions and beliefs about inquiry-based learning and how science is learned. TA's actions, as tutorial instructors, reflected their educational beliefs, student background and learning experiences. Practical recommendations for training teaching assistants to be tutorial instructors are included. Recommendations are appropriate for TA's required to use instructional methods that they have not experienced as students.

Tippins, Deborah

Strand 4 — Mon, 24 Apr, 1995, 8:30 AM, Redwood

The Role of Proverbs in the Construction of Knowledge about Science Teaching and Learning

William Veal — Katherine Wieseman

The process of knowledge reconstruction involves the creation of mental models. In this process, knowledge can be represented in various forms such as images, metaphors, narratives, propositions or inscriptions. Metaphor is one form of knowledge that has been used extensively to structure our understanding of science teaching and learning. The purpose of this study was to examine the utility of proverbs, as a special case of metaphorical understanding, to provide insight into cultural models and beliefs underlying experience. Novice and experienced elementary science teachers responded to and generated proverbs and interpreted them in the context of science teaching and learning. Key assertions were generated from analysis of teachers' interpretation of proverbs; these assertions revealed differences in novice and experienced teachers' cultural knowledge of science teaching and learning.

Tobin, Kenneth

Strand 3 — Mon, 24 Apr, 1995, 8:30 AM, Gold Rush A

Henrietta Hoffman — John Wallace — David Treagust — Barry Fraser
Dorit Maor

The study highlights the importance of good communication between hard working professionals and the pervasive effects of power, as it is socially invested in the roles of teacher and Department Chair, on the enacted curriculum and individual's construction of knowledge of chemistry. The ubiquitous patterns that emerged in this study usually are not visible in analyses of teaching and learning. The main implications of what we have learned relate to the professional actions of teachers in challenging environments. The bases for change are inherently dependent on factors associated with the communities and cultures in which teaching and learning are embedded. Accordingly, it seems to be an imperative that teachers not only know how to conduct research on their own practices but also how to initiate and sustain a program of school-based research and learn from it. Because teachers cannot be expected to act alone in reforming schools, additional resources and collaborations with university researchers are desirable.

Tomanek, Debra

Strand 4 — Tue, 25 Apr, 1995, 1:00 PM, Emerald

The Recruitment of Academically Talented Science Majors into Teacher Education

This paper is a discussion of a project recently implemented at the author's institution to determine whether academically talented science majors can be influenced to consider careers in secondary teaching through placement in classroom internships with carefully selected experienced science teachers. The results of the first phase of the formative evaluation indicate that the ten-week internships did have very positive influences on the career interests of the first group of students. One of the strongest indicators of success was the degree to which the teaching preference of the student interns matched the style of their assigned teachers. Other program effects are elaborated in the paper. The evaluation findings have implications for changing the quality of early field experiences for preservice teacher education students.

Toolin, Regina

Strand 4 — Mon, 24 Apr, 1995, 2:30 PM, California

Teaching Science in Elementary School: A Narrative of a Preservice Teacher's Attitudes and Perspectives about Science and Science Teaching

The purpose of this paper is to explore the attitudes and beliefs that a preservice elementary teacher (Anna) has about science and science teaching in relation to critical and feminist theories of science and education. How Anna's perspectives evolve over the course of the semester is a focus of this paper. The study was conducted in one section of "Teaching Science in Elementary School" in the Spring 1994 semester. Seventeen females and one male were enrolled in the course. Six students were part of an intensive group chosen according to criteria of availability and student diversity in terms of gender, race, and range of perspectives about science and science teaching. Interviews, reflective journals and classroom observation notes serve as primary data sources. Domain analysis (Spadley, 1979) reveals common themes about prior experiences in science, the nature of science and school science, influences on teaching learning, relationship between science and self-concept and the role of gender in science classrooms. A narrative is developed to illuminate these themes.

Treagust, David F.

Strand 1 — Sun, 23 Apr, 1995, 1:00 PM, Emerald

When Models and Analogies Go Wrong

Shawn Glynn — John Gilbert — Allan Harrison — Grady Venville
Sue Stocklmayer — Rod Thiele

Analogies have been likened to double-edged swords in that they are able to provide avenues for improved understanding of science concepts and at the same time may possibly cause new conceptions that are not acceptable from a scientific point of view. This symposium intends to look at the more dangerous side of this double-edged sword, when analogies and models go wrong. The overall aim of each of the presentations is to identify critical features that precipitate the problems associated with analogies and models which are used to help students learn science. The first perspective considers the broad issues of what happens when models are stretched too far. The second and third presenters, respectively describe instances, from the classroom and from science textbooks, when analogies were not successful in achieving their intended aims. The fourth presenter considers the problems created in understanding science concepts when analogies from an historical perspective are viewed as the scientific truth. The fifth presenter describes the problems that can occur when secondary models of representation are not clearly defined as the scientific concept.

Treagust, David F.

Strand 10 — Sun, 23 Apr, 1995 10:30 AM Emerald

Students' Conceptions

Reinders Duit

This paper reviews and analyses research on students' conceptions from a constructivist perspective, including specific examples from various science content areas. Sources of students' conceptions arising from sensual experiences, language, culture, and science instruction are described. Also details are provided of innovative teaching approaches based on the constructivist perspective. Finally, research-based recommendations for improving science teaching and learning are made.

Trowbridge, John

Strand 9 — Sun, 23 Apr, 1995 8:30 AM Monterey

Gulf Literacy: A Marine Science-based Model of Scientific Literacy

James Wandersee

A current and well-established trend in science education is the move towards the goal of scientific literacy, often condensed as "science for all". The Gulf of Mexico and its coastal environments are of great importance. Therefore, an understanding of the Gulf of Mexico should be part of the working knowledge of all coastal zone citizens and thus be part of K-12 science education. This research was guided by the following questions: (1) Can a meaningful model of Gulf literacy be developed? (2) how can a content analysis of coastal zone newspapers inform this model? and, (3) how can expert knowledge inform this model building? The development of Gulf literacy as a working or contextualized model of scientific literacy was constructed by content analysis of Gulf newspapers and expert interviews. Major findings from the content analysis of Gulf newspapers (n=579) and expert interviews (n=6) revealed 23 major principles or concepts that are crucial to an understanding the Gulf of Mexico as a large marine ecosystem. The resulting model of Gulf literacy, as portrayed by a series of concept maps, allowed for the development of a teachers guide to Gulf literacy. The section and linkage of important science concepts and principles to a broad science topic with local and regional relevance is an important consideration in instructional design.

Trumbull, Deborah J.

Strand 4 — Mon, 24 Apr, 1995 2:30 PM California

Fred and George: The Particularities of Becoming a Teacher

This paper reports on a longitudinal study of two new teachers. As with naturalistic and interpretive studies, the data cannot be reported in condensed form. Rather, the paper presents the stories of two teachers as they developed from their preservice years through the first years of teaching. The original aim was to document the changes that occurred in teachers' thinking and beliefs about the nature of learning, understandings of students, conceptualisations of biology and the purposes of teaching Biology, themselves as learners and good teaching and learning. The two stories reveal the complex interactions between the teachers' individuals histories and the settings in which they practice. An unexpected result of the study was the degree to which different metacognitive strategies played out in the work of teaching. The study raises several questions about teacher education and highlights the need for further study of how to produce changes in secondary Biology teaching.

Tuan, Hsiao-Lin

Strand 4 — Tue, 25 Apr, 1995 2:30 PM Emerald

A Case Study of Preservice Chemistry Teachers Pedagogical Content Knowledge Development

Bin-Yun Jen **Lyee-Juan Whang** **Rong-Chen Kaou**

The study investigated the development of pedagogical content knowledge from seven preservice chemistry teachers during one year of a practicum course. Shulman's (1986) and Cochran et al (1993) views of pedagogical content knowledge were applied as a research framework for investigation. Qualitative ways in collecting data included semi-structured interviews before and after each teaching experience; classroom observation and assignment collection. Themes of the practicum course included twice 20 minutes micro-teaching experience and a one month field experience. Interviews addressed subjects' views of the chemistry and the topics they taught, ways in transferring these content to students and general pedagogy they held. Finding revealed that after experiencing one year of the practicum course, most of preservice chemistry teachers' view of chemistry became simplified. On the contrary, their knowledge of teaching became more complicated and focused more on students' characteristics and learning style than before. They linked content and pedagogy together at the end of the year. Most of their teaching methods included terminology explanation and use of analogies. Many of them became aware of the importance in broadening their ways of explaining concepts besides simply knowing the definition of science concepts.

Tucker, Gary R.

Strand 3 — Tue, 25 Apr, 1995 8:30 AM Gold Rush A

TARPS V: Implications of the TARPS Model from the Instructional Technology Perspective

Carol L. Stuessy

Teachers must constantly use reflective practice to test the adequacy of their solutions to classroom teaching problems. Excessive demands on teachers and teacher time have been identified as explaining the lack of reflection and logic that teachers often exhibit in their planning and decision making. Advances in computer technology may potentially alleviate some of the burdens on teachers. Computers can cue, orchestrate and streamline operations and thus free teachers to participate in reflection and logical decision making. Visualization technology allows reports to be generated that highlight trends and patterns in teacher data generated during the planning, execution and assessment of lessons. Two visualization techniques, vector mapping and three-dimensional plotting, were used to visualize the TARPS model for teachers as they plan, execute and assess integrated mathematics and science lessons. Formative methods revealed a valid and reliable technology to assist teachers in the cognitively demanding tasks associated with teaching integrated mathematics and science in contextualised learning settings.

Tuss, Paul

Strand 5 — Sat, 22 Apr, 1995 8:30 PM Emerald

Intrinsic Motivation During a Summer Science Program for Academically Talented High School Students

The evaluation studies the quality of subjective experience in a sample of academically talented high school sophomores attending a scientific research apprenticeship program. An experience sampling methodology was employed to collect instantaneous, unanticipated records of the quality of student experience. On the basis of a rigorous principal components analysis, quality of experience was classified according to a two-dimensional taxonomy. The first factor, enjoyment, describes the more immediate domain of experience, while the second factor involvement, describes a more interpretive domain. It was also found that levels of involvement and, especially, enjoyment reported by students were strongly associated with their valuation and attainment of personal goal strivings. Females, however, reported pursuing different types of goals than did males. The experience sampling data were then used to evaluate the effects of various aspects of the research apprenticeship. Evaluation findings show that the highest quality experiences generally occurred during laboratory activities, as opposed to lectures; a few notable lectures, though, were shown to provide a suitable context for optimal experience. Except for black females, under-represented groups of students tended to perceive an excessive level of challenge during the program.

Uyeda, Steven M.

Strand 4 — Mon, 24 Apr, 1995 4:00 PM California

FRESCO: A Melding of Research and Practice

JodyLee Estrada Duck

Reform in science education is being looked at from many directions. There are however, only a few programs that try to bridge the gap between the researcher and the classroom practitioner. One such program is FRESCO, the Field RESearch COalition. FRESCO has three main strands that are woven together to form the fabric of the program. The first strand is science content. FRESCO returns the teacher to the role of student as primary science literature and research are introduced to the participants. Participants are removed from the classroom setting and are taken into the field to experience science instead of hearing about it. The second strand is pedagogy. As learners are introduced to science content, the results of research on teaching are modeled for the participants by FRESCO instructors. Emphasis is placed on transferring the newly acquired content knowledge and innovative teaching techniques to the classroom. The final strand is philosophy. Educational research is again explored in order for the teachers to develop as reflective practitioners, becoming metacognitive about how and why they interact with students the way they do.

Valero, Michel

Strand 9 — Sat, 22 Apr, 1995 7:00 PM Suite 2601

Problemas de Física de la Vida Cotidiana

La física y los fenómenos físicos aparecen en todas las actividades del hombre y su conocimiento nos permite entender mejor el mundo en que vivimos. Trataremos de poner en juengo las leyes fundamentales de la física en situaciones concretas, tan próximas a la vida cotidiana como sea posible. Estos problemas tienen por objeto desarrollar el sentido físico o sea obligar al estudiante a pensar, suprimiendole el recurso automático de las ecuaciones.

van Zee, Emily H.

Strand 2 — Sun, 23 Apr, 1995 10:30 AM Oregon

Conversations about Conversations about Science

Marietta Iwasyk, Akiko Kurose, Barbara Schnabel, Dorothy Simpson, Judy Wild

The teachers participating in this session have been documenting and analyzing conversations about science and mathematics in their own classrooms. Each teacher will lead a small group discussion that centers on interpreting a transcript analyzed in a study conducted by the teacher. Focal questions will include both conceptual and conversational issues. For example, what evidence does the transcript provide that one or more students were modifying their ideas during this conversation? How did comments and questions by students and the teacher facilitate this process? In particular, what seemed to prompt student questions that contributed to developing shared understandings? The teachers conducted their studies in subject matter contexts that included arithmetic, phases of the moon, electric circuits and forces. Class levels ranged from kindergarten to high school. These teachers share a common commitment to instruction that emphasizes development of scientific concepts through conversations among students in small groups as they gain experience with physical and biological phenomena. In addition to identifying ways of speaking that foster student inquiry, we consider issues that arise when teachers record and analyze discourse in their own classrooms. (Partially supported by NSF MDR-9155726)

Varelas, Maria

Strand 2 — Sun, 23 Apr, 1995 10:30 AM Gold Rush A

Doing Experiments: What Does It Mean For Children?

This paper centers around students' conceptions of scientific activity which emerged from a study of 12 Grade 3 and 12 Grade 4 students who have been learning science through an innovative curriculum. The children worked with the researcher in groups of three for about one to two hours, designing and carrying out an experiment which was motivated by a short story that they read. As a culmination of the story, the children were asked to explore the relationship between the height of the raised end of a ramp and the distance that a car travels on the ground after it rolls down the ramp. The aim of the study was to study students' conceptions related to issues such as: what we learn by doing an experiment, why we do an experiment if we already have formulated expectations for how it will come out, how we collect our data, which measurements we keep and which we throw away, whether we need to repeat a measurement more than once and if we do, how we understand the different values we get. Preliminary analysis of the transcripts of children's talk and actions point towards several interesting issues that will be explored in this paper.

Varrella, Garry

Strand 3 — Sun, 23 Apr, 1995 10:30 AM Washington

Expertise in Inservice Science Education: Restructuring Science Educators through SS & C/Chautauqua

Susan Blunck

The Iowa-SS&C effort was the SS&C site selected to test the efficacy of the Science/Technology/Society (STS) approach to teaching. NSTA has defined STS as the teaching and learning of the science in the context of human experience: (1) extensive assessment efforts characterised Iowa-SS&C. The 1993-94 interim assessment of successes with teachers, students, schools and communities continues with refinement of the modules that have been adapted and structured into unique scope and sequences. These modules also use the NSTA SS&C Core, (2) the Project 2061 Benchmarks and, (3) as criteria for judging the effectiveness of course structures and teaching strategies.

Viggiano, Elizabeth A.

Strand 4 — Sat, 22 Apr, 1995 7:00 PM Oregon

Teacher Conceptualizations of Science: Help or Hindrance for Improving Middle Grades Science Teachers' Classroom Practice?

Participants in the Science FEAT (Science for Early Adolescence Teachers) program reported making substantial changes in their teaching practice as a result of their experiences during the first summer of the program. Six of the teachers were the subjects of a previous study that indicated that, although each of these teachers did make dramatic changes in their classroom practices, the impact of the changes was hindered by the teachers' conceptualization of science as a collection of facts for students to master. The second summer of the Science FEAT program sought to address these conceptualizations by placing each teacher in a science research setting. This study examines the changes in four of the teachers' conceptualization of science as a result of having experienced the practice of science, and investigates the changes in classroom practice that result from their changed conceptualizations of science.

BEST COPY AVAILABLE

Vitale, Michael R.

Strand 2 — Sun, 23 Apr, 1995, 8:30 AM, Oregon

Evolution of a Model for Teaching In-depth Science in Elementary Schools: Longitudinal Findings and Research Implications

Nancy R. Romance

This paper identifies policy and research implications from an evolving model (IDEAS) for in-depth elementary science instruction emphasizing conceptual understanding that reflects recent developments in the fields of cognitive science and instructional design. In doing so, the paper presents: (1) a longitudinal overview of research findings showing the impact of the IDEAS model for teaching in-depth science upon the achievement (science, reading, language arts) and affective (attitude, self-esteem) performance of high-, average- and at-risk students in Grades 3-5, (2) an explication of the IDEAS teaching model developed over the past eight years in terms of basic and advanced classroom science teaching procedures and strategies, along with associated teacher training and support components, (3) an integrated overview of the major areas of research in science education, cognitive science, and instructional design that have provided a foundation for the development of the IDEAS model, and (4) the identification of both specific instructional policy issues and strategies for research focusing upon in-depth science teaching in elementary schools that follow from the implementation standards and interdisciplinary perspectives associated with the IDEAS model.

Vopava, Judy

Strand 3 — Sun, 23 Apr, 1995, 10:30 AM, Washington

Expertise in Preservice Science Teaching Across 10 National Sites: The Salish Project

The Salish Consortium is the first and only project sponsored by the Council of Scientific Society Presidents (CSSP) It was developed to evaluate 10 national science and mathematics preservice programs. The Salish Consortium is researching, evaluating and using its new knowledge to develop improved teacher preparation. Salish is assessing key variables in preserve education programs, then measuring the recent graduates and following their progress during the first three years of the new teaching careers. The project is linking the teaching variables to their teacher preservice program variables. The data are to be publicly debated and integrated into a redesign of mathematics and science preservice education across the ten institutions. The results of the first year data analysis at the program and teacher levels will address commonalities and unique characteristics of the 10 sites.

Wade, Philip

Strand 1 — Tue, 25 Apr, 1995, 8:30 AM, Washington

College Students' Conceptions of Science and Science Content

Norman Lederman

A survey to assess students' science background and understanding of the tentative nature of science was completed during a college introductory geoscience class. One hundred and eighty non-science majors were sampled. Students took a paper and pencil questionnaire on previous science coursework and a science content knowledge survey emphasizing geology, chemistry, oceanography, astronomy and mathematics. An open-ended survey was used to assess each student's belief about the tentativeness of scientific knowledge and to identify the various sources of their beliefs. At the end of the term, 75 students were interviewed to provide both a check on the validity of the paper and pencil surveys as well as provide an expanded format for each student to communicate their beliefs and knowledge about science. Included in the interview were questions concerning students' beliefs in what science is and their response to how science influences their lives. Students' scored a mean of 62% on the science content survey. Overall, students understood the tentative nature of science. The interview provided a clear view that the paper and pencil test did not always measure a student's knowledge and beliefs accurately. The interview highlighted several areas of science misconceptions. Students did not believe their knowledge of science would cause them to change their lifestyles. Many cited the tentativeness of science and personal beliefs as a reason to disregard scientific information.

Walberg, Herbert J.

Strand 10 — Sun, 23 Apr, 1995, 10:30 AM, Emerald

Instructional Strategies

Avi Hofstein

An overview is provided of the findings and implications of research into the effectiveness of teacher-centered and student-centered instructional strategies in science. Difficulties in attaining the goal of inquiry learning and in demonstrating the beneficial effects of laboratory work are considered. Educational productivity research suggests that no single instructional method will be effective in achieving all goals and that instruction is but one of numerous aptitudinal and environmental factors which affect learning. The effectiveness of laboratory activities, field trips and distance education are considered specifically.

Walberg, Herbert J.

Strand 10 — Sat, 22 Apr, 1995, 7:00 PM, Gold Rush A

Education's Big Ideas: Content Analysis of the Encyclopedia

Daoxin Lu Yu-Fen Chang

Neural network analysis was employed to find patterns of ideas in the 1994 *International Encyclopedia of Education*. As hypothesized, the distributions of cited authors and words are highly right-skewed (the higher, the fewer), corroborating previous studies of language, citations in the natural sciences, and many human behaviors. The network analysis showed about 100 word patterns that suggest frequent, salient, contemporary ideas about education. These could be classified into 13 clusters generally corresponding to academic disciplines and applied fields of education. Review of excerpts, titles of cited works, and cross-cluster associations suggests cognitive relations among these disciplines and fields. Network analysis seems a promising method for analysis of qualitative data and for practical analyses of educational texts.

Waldrip, Bruce G.

Strand 2 — Tue, 25 Apr, 1995, 2:30 PM, Washington

Science Laboratory Classrooms in Developing and Developed Countries

Geoffrey J. Giddings

This study attempted to compare the science laboratory learning environments of secondary schools in some developed and developing countries. The study used a version of the Science Laboratory Learning Environment Inventory that had been previously validated for a developing country context. Analysis of data generated found similar science laboratory learning environments across most high schools with one of the environment scales, Openendedness, as the least favourable scale. Overall students' attitude towards science were very favourable with boys having a more favourable attitude than girls. The study suggests that changes in teaching pedagogy has had little influence on the actual science laboratory teaching practices and that science teaching is so culturally bound that it has inbuilt resistance to change.

Wallace, John

Strand 3 — Sun, 23 Apr, 1995, 4:00 PM, Suite 2601

Science as Content, Science as Context: Working in the Science Department

Helen Wildy

This case study explores the way the science department shapes the relationship between a department head and a teacher as they grapple with their expectations and responsibilities. Data sources included video records of the teacher in her classroom, field notes and interviews with the teachers, the department head, the principal and a selection of students. We find that the values and beliefs of the department head encompass a view of teaching, leadership and organisation to which science is central. The teacher in this study does not share this vision. Science, for her, is a vehicle for other agendas. She experiences the weight of subject attempting to bring her into the subculture of the science department. We argue from the case study that the subculture of the science department shapes a particular view not only of teaching but also of leadership, one that is primarily concerned with developing and maintaining the status of the department and the subject of science. We suggest, too, that just as the powerful subcultures of subject departments can oppose curriculum reform efforts, so they can operate to impede efforts to reform leadership within schools.

Wandersee, James H.

Strand 1 — Mon, 24 Apr, 1995, 8:30 AM, Oregon

An Emergent Typology of Biology Relations Used in *AAAS Benchmarks*

Kathleen M. Fisher

This research was based on data collected via semantic network analyses of representative sampled of biology literacy goals from the *AAAS Benchmarks in Science literacy* (Project 2061, 1993). The research aims to answer the question: What are some of the key relations used by biology educators to link biology concepts for presentation to K-12 students? We also explore the relative benefits and costs of using many or few relations. Theoretical antecedents for this work are derived primarily from research on relations in artificial intelligence and cognitive psychology, especially Quillian (1968, 1969), Sowa (1983), Gentner (1978, 1981a, 1981b, 1981c, 1982) Graeser, Millis & Long (1986), and Gordon & Gill (1989). The resulting typology of biology relations should be helpful to those who (a) use concept mapping and semantic networking in teaching and learning biology; (b) use concept mapping and semantic networking to analyse dialogs or text in biology; and (c) are interested in the nature of biological knowledge.

Watson, Scott B.

Strand 2 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

The Relationship Between Formal Operational Thinking Ability and Prospective Grade Level to be Taught for Preservice Education Majors

Juliana R. Baker

The purpose of this study was to determine the relationship between preservice teachers' levels of formal operational thought and the grade level they intend to teach. *The Test of Logical Thinking* (TOLT), developed by Tobin and Capie (1981), was utilized to measure logical (or formal) thinking abilities of collegiate elementary, middle grades and secondary education majors. These cognitive abilities were correlated by statistical analysis with the preservice teachers' intended grade levels. Inter-group comparisons between the three major groups (elementary, middle grades and secondary) were also conducted. The directional research hypotheses stated: (1) a significant positive correlation will exist between the level of formal operational thought for preservice teachers and the prospective grade level they intend to teach, and (2) significant differences will exist between the observed and expected frequencies in the level of operational thinking for the three major groups. Results of the correlational analysis indicated a significant, positive relationship. Significant differences existed between the observed and expected frequencies in the level of operational thinking as measured by the TOLT and these differences were in the hypothesized direction as indicated by Chi Square analysis.

Watters, James

Strand 4 — Sat, 22 Apr, 1995, 7:00 PM, Redwood

Origins of and Changes in Preservice Teachers' Science Teaching Self-efficacy

Ian Ginns

This paper reports on a study of factors that contribute to science anxiety and science teaching self-efficacy among preservice primary and early childhood teachers. The experiences and beliefs of an intake of primary and early childhood preservice teachers were explored in an ethnographic research tradition. In all 366 students from four cohorts were studied. Students' self-efficacy, attitudes to science and academic self concept were measured at the commencement and conclusion of the semester of study and selected students were interviewed at various stages of the semester in order to explore these issues in a qualitative mode. The salient outcomes revealed that, personal science teaching self-efficacy was associated with negative high school experiences, but could be improved in situations where individual students experienced support through an appropriate learning environment. Outcome expectancy also could be improved through experiences in which students successfully implemented teaching programs to children. Analysis of qualitative data revealed interesting contrasts between students. A series of assertions about the causative factors that may influence the development of students' sense of self-efficacy are presented.

Weiss, Iris

Strand 10 — Tue, 25 Apr, 1995, 10:30 AM

Science Teaching in the United States: Implications for Implementing the National Standards

Data from the 1993 National Survey of Science and Mathematics Education indicate areas where science teaching is getting closer to the vision embodied in the National Science Education Standards in some areas, but remains quite far from the ideal in many other areas. This session uses data from the 1993 survey as well as trend data from comparable surveys conducted in 1977 and 1985-86 to address questions about teacher preparation in both content and pedagogy; teacher attitudes toward current reform ideas, and the status of classroom science instruction. The survey results, as well as results of research on Statewide Systemic reform initiatives, are used to identify barriers to effective and equitable science and mathematics education and to discuss implications for policymakers.

Welicker, Miriam

Strand 5 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

Performance Tasks and Performance Assessment of High School Students Studying Primary Prevention of Cardiovascular Diseases

Reuven Lazarowitz

A learning unit on primary prevention of cardiovascular diseases was taught to Grade 10 students (N=192) using two methods of instruction and assessment in laboratory. The study goals were: (1) developing performance tasks and a multidimensional assessment instructions (MDAI) and, (2) evaluating students' mastery of inquiry skills, preferences, attitudes toward instructional and assessment method and descriptions of their learning activities. The experimental section (N=123) performed laboratory work using performance tasks, while being assessed by their teacher and two observers. Thus students were assessed during performance tasks and by summative tests. The control section (N=89) performed experiments according to the regular Biology curriculum and were assessed only by summative tests. Performance tasks were STS oriented and included hands-on investigations, using "advance organizers" (Ausubel, .968) and aimed toward meaningful learning (Driver, 1981). Tasks were characterized by a sequence of: individualized learning; group learning; class discussion and individual summative application. The study lasted three months, including pre- and post-tests administration. Experimental group demonstrated greater gains in mastery of inquiry skills (indicating their meaningful learning), positive attitudes and preferences of performance tasks.

Weller, Herman G.

Strand 4 — Tue, 25 Apr, 1995, 1:00 PM, Emerald

Helping Teachers to Pursue Nature's Questions: Teachers' Changing Conceptions of Science and of Teaching Science

Mary Dickinson Bird

This is a report on an endeavor at a northeastern university to help 21 elementary teachers experience during a three week summer academy an alternative mode wherein the questions that nature and the physical world *ask us* lead to investigations in which concepts and principles are learned - i.e. to help the teachers act as scientists. We have analyzed the teachers' reflections upon their own science-teaching practice in terms of Smyth's (1989) four forms of action. We have also looked for any influence upon their passage through these stages of their changing conceptions of *what scientists do*. The present report is based on the participants' personal journal writings and their descriptions of prospective curricular units. At least 81% of the teachers apparently did alter their conceptions of teaching (no necessarily their science teaching) in the forms of action described by Smyth. There was a wide variation of degrees to which each teacher passed through each stage and in the extent of progression from stage one to stage four. The teachers' passage through Smyth's four stages seemed to be affected more by the manner in which the academy process empowered them to explore and pursue questions from nature, than from their somewhat limited new conceptions of *what scientists do*.

Wesso, Iona

Strand 2 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

Translating the Reading of Scientific Prose into Thinking and Understanding

Understanding scientific text is a cognitively demanding task and requires complex and integrated cognitive abilities which many students do not have. This paper reports on an intervention aimed at the development of schemata for text based on the organisation and relations of ideas presented in scientific text. Graphic organisers (GOs) representing six categories of organisation found in scientific text were developed. Students were trained in the use, purpose and construction of the GOs through an instructional procedure developed according to principles articulated by Engelman and Carnine. The use of content-specific GOs facilitated systematic and planned exploration of text and connect information into a coherent structure. Students recall and interpretation on ideas improved and they acquired the ability to focus on important information at the expense of trivia. This study showed the schemata for different text types, can be taught and provide a valuable framework for information. Since internal connections are built among ideas in the text, one can expect better recall of high conceptual rather than low conceptual material and relatively better problem-solving application than verbatim retention.

Westbrook, Susan

Strand 1 — Mon, 24 Apr, 1995, 4:00 PM, Nevada

Evaluating Conceptual Development in an Integrated Context: The Case of Density and Slope

Laura Rogers

The purpose of this investigation was to explore conceptual development in an integrated physical science and introductory algebra course called SAM 9. Twenty-eight Grade 9 SAM 9 students and 72 students in a traditional physical science course participated in a learning cycle investigation of density and flotation. The SAM 9 students also explored the representational and mathematical relationships between slope and density; the physical science students did not. Conceptual development was assessed using concept maps, word sorts, application scenarios, interviews, recordings and direct classroom observations. At the conclusion of the investigation, the SAM 9 students exhibited greater understanding of the relationships between the mathematical and science concepts. Implications for implementation of integrated curricula at the high school level will be addressed.

White, Barbara Y.

Strand 7 — Sun, 23 Apr, 1995, 2:45 PM, Portola

The Thinker Tools II Project: A Computer-based Curriculum for Scientific Inquiry and Modeling

John R. Frederiksen

In this presentation, we will describe the ThinkerTools II Project which is a collaboration between researchers, software designers and middle-school teachers. The goal is to create materials that will facilitate the teaching and learning of scientific inquiry and modeling, while helping students to develop a knowledge of the physics of force and motion. To accomplish these goals, the project has developed software and accompanying curricular materials that enable science classes to function as research communities. In these classes, inquiry is the basis for developing an understanding of the physics. Students carry out research in groups, using computer simulations and real-world theories to account for their experimental findings. The groups then meet to report on their results and to agree on a model for the phenomenon under investigation. This approach to teaching scientific inquiry and modeling was implemented last year by three teachers and one student teacher in fifteen of their classes. We will describe: (1) the ThinkerTools II software, (2) the curricular materials, teacher's guides and assessment activities, and (3) the results of the experimental trials of these materials in the Berkeley and Oakland public schools.

White, Robyn

Strand 10 — Tue, 25 Apr, 1995, 2:30 PM, Emerald

We Need Heroes in Science Education: Fact or Fiction?

This study examines the comparative influence of several highly visible science educators in promoting science curriculum change in the state of Western Australia. Data collection involved interviews with key informants, the examination of private and public archival records as well as interviews with, and classroom observation of, current science teachers. The analysis of recently collected material consistently led to new insights and some shifts in focus as the study proceeded. The study found that successful "heroes" who were identified with significant long term change were able to change the myths, rituals, ceremonies and artefacts of the science education community. These "heroes" were given authority by the community to lead science education into a new era. Where there were no "heroes" nothing seemed to change despite government allocated resources.

Whitworth, Joan M.

Strand 5 — Tue, 25 Apr, 1995, 2:30 PM, Gold Rush B

Curriculum Reform: A Case Study of Fairview Middle School

Based on 41 days of on-site data collection, this case study is focused upon a middle school implementing a major science education reform based on the National Science Teachers Association's (NSTA) Scope, Sequence and Coordination Project (SS&C). The purpose was to obtain a comprehensive view of a successful reform endeavor from the perspective of the participants: students, teachers, administrators and university personnel. Information was obtained concerning: (1) the nature of the reform, (2) the influences, results and dilemmas experienced by the various reform participants, (3) the varied perspectives of the participants and, (4) the role of systems thinking in understanding the reforms. The teachers have played a key role; in addition to their normal role of classroom practitioners, they also have assumed the duties of curriculum writers and developers. Although many of the teachers have struggled with the reform, it appears that the extra effort has its rewards in improved student attitudes toward science and increased student understanding of science concepts. The reform was difficult and has required much hard work and commitment on the part of the participants. Sustaining the reforms has required all levels of the educational system (state, district and local school) to work together and provide support structures for the teachers.

Wiggins, John R.

Strand 4 — Mon, 24 Apr, 1995, 8:30 AM, Suite 2601

A Staff Development Model: Hands-on and Minds-on, Museum Based Science Instruction

B. Kim Nichols

The aim of this study was to examine the impact of a staff development program designed to enhance science content knowledge and introduce a new approach to teaching science among upper elementary and middle school teachers. This approach integrated the expertise of a major research institution's science faculty with a hands-on/minds-on, museum-based model of science instruction. This staff development model had three primary components: (1) a one week science learning experience which integrated physical science content with training on production and use of interactive demonstrations in the classroom setting, (2) a one week summer camp for children during which teachers practised newly learned concepts and strategies, and (3) follow-up support throughout the year via teleconference sharing sessions. Results from quantitative and qualitative methodologies indicated that the staff development had a significant and positive effect on the teachers in terms of their knowledge of the concepts and strategies introduced during the workshop and on their ability to develop, plan and teach lessons consistent with the staff development approach to science instruction.

Wildy, Helen

Strand 2 — Mon, 24 Apr, 1995, 2:30 PM, Washington

What is Being Understood When Good Science Teachers Teach for Understanding?

John Wallace

This study tells the story of the evolution of our ideas about good science teaching. We examined the classroom practice of an experienced physics teacher as he adapted his teaching to meet the requirements of a new syllabus based on constructivist notions. Our close observation of this teacher in his Grade 11 classroom, over several months, revealed that he did not fit the mould of the constructivist teacher and yet there was much to suggest that he was meeting the needs of his students. He was teaching for understanding, but understanding of a different kind than we first expected. We argue for a broader view of good science teaching than that proposed by the constructivist literature, one of that takes account of teacher confidence, the structure of the discipline, student motivation, a relationship of trust between teacher and students and the cultural context of learning.

Willhite, K.T.

Strand 3 — Sun, 23 Apr, 1995, 8:30 AM, Emerald

Elementary Teachers' Perceptions of Science Education, Classroom Practices and Professional Development

The purpose of this study was to evaluate and assess the change experienced by 33 elementary classroom teachers after their participation in a grant project designed to improve math, science and technology at the elementary level. Teachers involved in this project participated in intense summer institute training, monthly professional development meetings, and classroom mentoring. Those who were involved with the project from beginning to end, completed a pre-post science attitude scale. All subjects completed a written assessment designed by the researcher, and were individually interviewed. Data collected were qualitatively analyzed through the triangulation of the interview protocols, the assessment responses and field notes. A t-test of the science attitude scale further enhanced the triangulation. The triangulation supports the premise of the grant for improvement of math, science and technology.

Williamson, Vickie M.

Strand 2 — Sun, 23 Apr, 1995, 2:45 PM, Oregon

The Effects of Verbal Explicitness on College Chemistry Students' Mental Model Building

Kenneth C. Williamson

The purpose of this study was to examine the effects of gender on the level of problem explicitness and the order of problem presentation. The sample consisted of 166 students enrolled in a Fundamentals of Chemistry course intended for health and non-science majors at a suburban Midwestern university. Mental model theory provided the basis for the study. Three whole-part or proportional questions of each of the following three levels of explicitness were used: (1) fully quantified and connected (high), (2) not quantified but connected (medium), and (3) neither quantified nor connected (low). This provided a total of nine problem statements. With respect to order of presentation, there was a significant main effect. The interaction of order and gender was significant only with low explicit problem statements. When presented with high explicit questions first, females significantly outscored their male counterparts on the low explicit questions. However, when presented with low explicit questions first, females scored significantly below the males on the low explicit questions. With declining numbers of females in chemistry, implications are that they, along with the males, will benefit from teaching that presents highly explicit problems first, then incrementally moved towards low explicit questions.

Wilson, Julie L.

Strand 4 — Mon, 24 Apr, 1995, 4:00 PM, Suite 2625

Salient Beliefs about a Demonstration Classroom in Conjunction with a Problem Solving Inservice

The purpose of this study was to identify salient beliefs about an alternative inservice format. Thirteen teachers were involved in a twelve month inservice which focused on having teachers incorporate an integrated math/science/problem solving format into their classes. Teachers partook in an inservice, received optional in class feedback and observed expert problem solving teachers in their class using the clinical supervision mode. A pilot interview schedule was developed through interviews and focus groups following the first demonstration classroom. A final interview was conducted at the conclusion of the inservice. Results suggest that teachers found this inservice structure beneficial. Teachers specifically spoke about addressing their personal instructional needs pertaining to problem solving, observing specific strategies found in problem solving, observing the context of the student, redefining their problem solving understanding, reflecting on their instructional practice and increased collegiality.

Wong, E. David

Strand 1 — Sun, 23 Apr, 1995, 2:45 PM, Gold Rush B

The Challenge and Potential of Self-generated Analogies with Elementary School Science Students

In previous research, I have explored the potential of self-generated analogies as a tool for constructing and evaluating explanations. With self-generated analogies, individuals generate their own comparisons between the phenomenon in question and a related, more familiar phenomenon to create a representation that is accessible to description and analysis. The central questions in my program of research have been: Can students use a series of self-generated analogies to bring about change in their understanding of what the nature of this change is? In a previous study, changes in understanding for adults of varying science background ranged from the emergence of new explanations to the raising of important questions about the nature of the phenomenon. The next step in my research program was to examine the potential of self-generated analogies with younger, upper elementary-age participants. Results from three years of work have revealed the promise and the challenge of this kind of reasoning with young students. Issues about the nature of analogical reasoning and the nature of school learning are discussed.

Wood, David A.

Strand 5 — Tue, 25 Apr, 1995, 9:30 AM, Redwood

Physics Curriculum Reform: Teacher Initiated Change?

This paper describes a major senior secondary physics curriculum reform that is transforming the way in which physics is being taught in Western Australian upper secondary schools and highlights the difficulties experienced by the curriculum committee responsible for managing the change. The paper addresses the difficulties through the eyes of a key player in the change process and highlights the role of teachers in identifying the need for change, the need for curriculum developers to seek alternative solutions to curriculum problems, the place of assessment in ensuring implementation of new teaching approaches and sustaining the change, the need for change to be gradual and the importance of financial and political implications of curriculum change. The major purpose of the research was to provide recommendations to the central accreditation and assessment agency and the schools sectors (Education Department, Catholic Education Office and Association of Independent Schools) concerning the management of course review and development and the implementation of new courses.

Woodin, Terry

Strand — Tue, 25 Apr, 1995, 1:00 PM, Oregon

National Science Foundation Initiatives in Teacher Preparation

The session will explore the National Science Foundation's (NSF) initiatives to support collaborative efforts by science, mathematics and education faculty to reform undergraduate and pre-certification efforts in the mathematics, science and technological preparation of teachers, K-12. Initiatives within the Division of Undergraduate Education (DUE) include:
1. The NSF Collaboratives of Excellence in Teacher Preparation supporting projects focused on systemic (multi-institutional and multi-departmental) reform of teacher preparation programs and
2. Projects focused on one course or a series of courses. Also initiatives within other Divisions of the Directorate for Education and Human Resources will be considered.
There will be a brief presentation of the programs and ample opportunity for discussion of current efforts and audience suggestions concerning future directions.

Woods, Corey S.

Strand 6 — Sat, 22 Apr, 1995, 8:30 PM, Emerald

The Influence of Race, Ethnicity, Gender and Grade Level on an Acceptance of Evolutionary Theory among Secondary Science Students

Lawrence C. Scharmann

Studies involving students' acceptance and understanding of evolutionary theory indicate that American youth do not use an acceptable scientific framework to interpret evolutionary theory and related principles. Race, ethnicity and gender are integral parts of a student's heritage and identity. Hence, the four major objectives of this study are to determine the influence of: (1) race, ethnicity and gender, (2) logical thinking, (3) locus of control and, (4) grade level with respect to an acceptance of evolutionary theory. The subjects of this study were students (n = 517) enrolled in various secondary science courses in a high school in a Midwestern city with a population of approximately 50,000, during the Spring semester of 1994. The researchers used both quantitative and qualitative research methods to answer the research questions. The quantitative data consisted of scores on the GALT, the LOCUS, the W-SESI. The qualitative data consisted of transcribed audio-taped interviews. This study is a works in progress and therefore there are not results to report. However, discussion will focus upon the influence of race, ethnicity, gender and grade level on an acceptance of evolutionary theory among secondary science students.

Woods, John D.

Strand 2 — Sun, 23 Apr, 1995 8:30 AM Emerald

Utilizing Feedback Data on Students' Perceptions of Teaching Style and Preferred Learning Style to Enhance Teaching Effectiveness

Barry J. Fraser

Several instruments have been developed to monitor students' perceptions of different aspects of classroom environments, but few studies have monitored the extent to which teachers are able to utilize feedback from such instruments to enhance their teaching effectiveness. Teachers were provided with feedback from the administration of the Classroom Interaction Patterns Questionnaire (CIPQ), a new instrument designed to monitor student perceptions of teaching style and preferred learning style, together with qualitative data based upon observation, interviews and case studies. Intervention strategies, based on these data and designed to improve the classroom environment, were introduced in an experimental group but not in a control group. The intervention period covered five weeks. The control group received no feedback data. Analyses showed that the experimental group had been able to bring about more positive changes in student perceptions than the control group (i.e. the gap between students' perceptions of teaching style and their perceptions of their preferred learning style had been reduced).

Woolnough, Brian E.

Strand 10 — Sun, 23 Apr, 1995 10:30 AM Crystal

The FASSIPES International Project: Factors Affecting Student Choice of Career in Science in Six Countries

The purpose of this project was to investigate factors, both in school and out of school, which affected students' choice towards careers in science. Parallel surveys, using quantitative and qualitative methods, were addressed to 18 year old students in Australia, Canada, China, England, Japan and Portugal. This Paper Set brings together four papers arising from different countries in this survey; providing an overview and comparison of the result; comparing urban and rural students from Australia; considering gender differences in Canada and considering the effect of different approaches to teaching science in Japanese schools. In each country the effect of different types of activity in school science, the factors which encouraged them towards science careers and the students' ability, home background and personality traits were considered.

Wright, Emmett

Strand 4 — Mon, 24 Apr, 1995 8:30 AM Redwood

Interpretive Analysis of Secondary Teachers' Use or Non-use of Inservice-provided Curriculum Innovations

Luke Shokere

Although the phenomenon of teacher change is associated with a complex network of processes, when studied in the context of how resource-supplied teachers decide to voluntarily implement novel information derived from instruction-based enhancement programs, a clearer set of factors can be elucidated. In an ethnography of resource-supplied implementers, and nonimplementers who descended from an exposure to novel approaches to teaching precollege genetics, a conceptual framework that viewed the process of teacher change in relation to design and delivery (enhancement programmatic effects) and receptivity issues (teachers' perceptual and contextual setting effects) was used. An analysis of pedagogical profiles disclosed that teachers' incentive structures should also be assessed; therefore, these data suggested a revision of the commonly applied conceptual framework. An empirical assertion was constructed: science teachers that are equally prepared to implement curricular novelties tend to do so only if their conception of "being a science teacher" is congruent with testing proposed curricular innovations. Recommendations for refining the scope and management of teacher enhancement programs to promote optimal utilization of inservice content will be discussed.

Wynne, Cynthia F.

Strand 1 — Sun, 23 Apr, 1995 4:00 PM Monterey

High School Students' Use and Revision of Models of Meiosis in Solving Inheritance Pattern Genetic Problems

The purpose of this study was to determine how students use and revise explanatory models in genetics—in this case meiotic models—in a well-known problem solving classroom. In this classroom, students were engaged in constructing genetic models of inheritance patterns and meiosis in order to account for data that were generated by Genetics Construction Kit (GCK) software. Data for this study, generated over an eight week period during which students solved GCK problems, consisted of transcripts of student talk, interviews with students and student laboratory notes. Analyses of the data suggest that students use meiotic models to recognize anomalies as well as to generate, challenge, test and justify hypotheses. Importantly, students also revise these models by changing certain of their objects (such as number of alleles/individual), processes (such as independent assortment) and states (such as linked). These findings are significant as they show that students, who are rarely given the opportunity to construct explanatory models in traditional science classrooms, are able to use and revise such models in order to recognize and explain data which is anomalous to them. The students are thus engaged in aspects of science process.

Yager, Robert E.

Strand 2 — Mon, 24 Apr, 1995, 4:00 PM, Washington

Students Motivational Patterns and Instructional Strategies in STS and Non-STS Science Classrooms in United States Schools

This paper describes: (1) the adaptation and development of two instruments for assessing students' motivational profiles and preferred instructional strategies and, (2) reports comprehensive validation information on students in Iowa schools whose teachers took part in a comprehensive state-wide in-service program (Iowa Chautauqua). Two sections of middle school students were selected for standard textbook instruction for an entire semester. Two other sections taught by the same teacher were taught with an STS student-centred approach. The ten teachers were selected because of their high score on the Scale for Analysing STS/Constructivist Teaching Practices. In the textbook section all ten teachers reported a similar pattern of student motivation as reported in previous studies. However, in the STS sections, the diversity of student motivation was found to be non-significant. Apparently the STS approach—when practiced by accomplished and successful teachers—is effective in motivating a great variety of students that the same teachers are not able to demonstrate in more traditional class settings where the textbook is a required part of the course offering.

Yeany, Russell

Strand 4 — Sat, 22 Apr, 1995, 7:00 PM, Redwood

An Examination of Interview and Self-report Measures of Elementary Teachers' Self-efficacy in Teaching Science

J. Steve Oliver — B. Kim Nichols — Renna Calvert — M. Jenice French

This study was designed to involve 12 teachers at each of three elementary schools in the State of Georgia. The teachers were all volunteers who agreed to participate in a project to implement Quality Core Curriculum resource guides (which consisted of hands-on science activities) in their classrooms. This study evaluated self-efficacy of elementary teachers using both an interview and self-report format. The measurement of self-efficacy in these formats allows for comparison as well as validation of the self-report. The clearest finding from this study is that teachers of elementary science are open to the inclusion of hands-on science activities if they are provided with resources and training to implement them. As a result, the researchers conclude that science teachers self-efficacy as indicated in this study is a function of not only teacher knowledge of science, but more importantly teacher knowledge to the specifics of what they are being called on to teach.

Yeroslavski, O.

Strand 5 — Sun, 23 Apr, 1995, 8:30 AM, Monterey

The Effect of Teaching the Cell Topic Using the Jigsaw Method on Students' Achievement and Learning Activity

Yehudit J. Dori — R. Lazarowitz

The research studies the effect of teaching the cell topic using various methods on students' achievements and learning activity. The experimental group studied by the Jigsaw method, while the control group studied by the customary frontal method. For the Jigsaw method, a study unit on the cell topic has been developed, divided into five independent subtopics and included theoretic and laboratory skill elements. The class was divided into heterogeneous groups and each student was assigned one of five subtopics. The students formed "expert" homogeneous groups, whose task was to study together the same subtopic and prepare it for the next phase. They returned to the heterogeneous groups, there each student taught the topic prepared in the expert group and had to study the other subtopics from peers. The students who studied by the Jigsaw method had higher achievements in the test on the cell topic than those in the control group, especially those with medium academic ability. In the experimental classes, the cooperative learning activity increased and positive attitudes towards the Jigsaw method were found. The research indicates that the Jigsaw method should be used in teaching Biology in general and the cell topic in particular.

Yore, Larry D.

Strand 2 — Sun, 23 Apr, 1995, 8:30 AM, Oregon

Explicit Science Reading Instruction in Grade 7: Metacognitive Awareness, Metacognitive Self-management and Science Reading Comprehension

David J. Spence — Richard L. Williams

This study investigated the associations between metacognition (awareness and self-management) and comprehension of science text, the effects of teaching comprehension strategies on metacognition and comprehension and the differential learning effects on reading ability and gender groups of 27 Grade 7 students. The study involved a single group pretest/posttest design and was carried out over 22 weeks. Reading strategies were taught using an explicit model of instruction embedded in the regular teacher-oriented science instruction. The strategies taught were: (1) using text surface structure, (2) accessing prior knowledge, (3) learning metacognitive self-appraisal and self-management, (4) identifying main ideas and new concepts, (5) using context for understanding word meaning, and (6) summarizing. Pretest results indicated a nearly significant ($p \leq 0.05$) association between metacognition (awareness) and success on science reading comprehension tasks. Posttest results indicated significant and nearly significant associations between metacognition (awareness and self-management) and reading comprehension. Significant improvement between pretest and posttest results of metacognitive awareness, metacognitive self-management and reading comprehension were found. A differential learning effect was evident on all three dependent variables favoring the lower ability readers. Likewise, differential learning effects favoring male students were noted on metacognitive awareness and comprehension tasks. No such differential learning was found for metacognitive self-management.

Young, Deidra J.

Strand 10 — Sun, 23 Apr, 1995 10:30 AM Crystal

Factors Affecting Student Choice of Career in Science: Students from Urban and Rural Schools in Australia

Barry J. Fraser Carolyn Montgomery Joanne Tims

This FASSIPES study was conducted over two years in Australian high schools and involved the use of qualitative and quantitative methods. Year 12 Science students from 20 high schools in rural areas of Western Australia and urban areas of Perth were surveyed. The results of this study clearly indicated that, for many students who were intending to pursue a career in engineering or science, an interest in science was sparked in their early years of high school, by a dynamic teacher or a special science program. Many students intending to pursue a career in engineering or science cited a significant person (often, but not always a relative) as the main influence on their decision. This paper notes the differences between students from rural and urban schools.

Yu, Shu-Mey

Strand 1 — Mon, 24 Apr, 1995 8:30 AM Monterey

Elementary Students' Conceptions in Ecology

The purpose of this study was to investigate Grade 6 students' conceptions about biotic community using classroom observations and semi-structured interviews. Subjects were 47 6th graders from an elementary school in Taichung, Taiwan. The intact class was observed during biotic community related science units learning. The interview task was developed, pilot tested and revised. Interview topics were: (1) the role and relationships of producers, consumers and decomposers, (2) population and, (3) biotic community. Clinical interviews were conducted subsequently by a research team. All classroom observations and interviews were vide- and audio taped for later transcription and analysis. Students' conceptions determined from both classroom observations and interviews were cross-checked and analyzed. A summary of the results obtained is given.

Zadnik, Mario G.

Strand 7 — Sun, 23 Apr, 1995 1:00 PM Portola

Educational Aspects of Developing a Computer-based Multimedia Physics Instructional Package for Students with Limited Physics Backgrounds

Robert D. Luso David F. Treagust

To assist non-physics majors with limited backgrounds undertaking introductory physics courses, the authors have been developing a computer based multimedia instructional package. The package covers most of the concepts typically encountered in the first few chapters of introductory university physics textbooks. The development phase of this work has raised a number of significant educational and presentational issues in computer-based multimedia instruction. Observations and extensive student evaluations of the package have shown that while there are still a number of major difficulties to overcome, the package has a number of positive features. These include: ease of use, a greater degree of engagement over similar material covered in physics textbooks and accommodation to individual learning styles. A surprising feature is the gre- ter acceptance of the package by female, as compared to male, users.

Zandvliet, David B.

Strand 5 — Sun, 23 Apr, 1995 8:30 AM Emerald

A Comparison of the Computer Administered and Written Forms of Multiple Choice Testing

Pierce Farragher

The design of a computer administered test is described and the potential advantages and disadvantages of this general type of testing is discussed. A computer testing program designed by the author using Hypercard was tested for equivalence with written formats of a test. The study grou consisted of fifty adult basic education students enrolled in an introductory computer course. Each student completed a schedule of three written and three computer tests. Additional information about these tests was collected through the use of student pre and post surveys and through the use of an innovative Hypercard script which tracked a students' path through the tests. The results of the comparative analysis of tests scores indicated no significant differences in test scored attributable to the computer or written format of the tests. Survey responses indicated a student preference for the computer format of the test over the written format and this preference increased after exposure to the computer administered tests. Finally, an analysis of the student test path data recorded by the computer indicated that the computerized tests took on average two minutes longer for students to complete.

Zeidler, Dana L.

Strand 8 — Sun, 23 Apr, 1995 10:30 AM Suite 2601

Of Maggots and Saints: The Central Role of Fallacious Thinking in Science Education

This paper argues that understanding the central role of fallacious thinking is fundamental to the eventual success of realising the goals advanced by AAAS. Direct instructional approaches are not likely to change teachers epistemological frameworks with respect to their understanding of the development of scientific concepts. Faulty reasoning can be expected to be met with psychological resistance. The purpose of this paper is to present a summary of errors, biases and fallacious reasoning with emphasis on socio-scientific reasoning. Hypothetical samples of students' thoughts which exhibit various fallacious arguments and thinking will be presented for analysis. The role of anomalous information in changing pedagogical and conceptual misconceptions will also be addressed.

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Zietsman, Aletta

Strand 10 — Sun, 23 Apr, 1995 1:00 PM Monterey

Developing a Teacher Education Activity while Researching Students' Knowledge

Students teachers (ST's) participated, as researchers, in a project that investigated students' knowledge of acquired inheritance. The effect of the ST's involvement in the project on their content knowledge and beliefs about teaching and learning were investigated. At the entry level of the study the ST's were interviewed about their beliefs and about concepts in acquired inheritance. During a workshop on clinical interviewing ST's participated in the development interview questions. ST's then interviewed two students each, transcripts were analyzed in a workshop; the cycle was repeated and in an "exit" workshop, the transcript analyses were completed and exit interviews with the ST's were conducted. Preliminary results show ST's developing an understanding of the complexity of learning and teaching and awareness of their own knowledge of genetics.

Zohar, Anat

Strand 1 — Tue, 25 Apr, 1995 1:00 PM Emerald

Creating a Learning Environment to Induce Development in the Control of Variance Thinking Strategy

The purpose of this study was to explore a newly created learning environment designed to induce development in students' control-of-variables thinking strategy. Thirty-three Grade 8 and 9 students were interviewed before and after instruction. The results show a large increase in the percentage of students' valid inferences. Students were subsequently able to transfer their newly acquired thinking strategies to a new problem. A case study analysis of the learning process indicates that the teaching of higher order thinking skills must be gradual, to allow enough time and practice for stabilization of the acquired thinking strategies.

Zoller, Uri

Strand 1 — Mon, 24 Apr, 1995 10:30 AM Oregon

Algorithmic and Logs vs. HOCS Chemistry Examination Questions

Aviva Lubesky **Yehudit J. Dori**

The performance of freshmen Chemistry and Science majors and inservice Science teachers in two Israeli universities on algorithmic, lower-order cognitive skills (LOCS), and higher-order cognitive skills (HOCS) Chemistry examination questions was investigated. The driving force for the study was an interest in moving science and Chemistry instruction from an algorithm-oriented, factual recall approach dominated by LOCS to a decision-making, problem solving and critical system thinking approach, dominated by HOCS. HOCS exam questions were scored and analyzed for correlations and differences between the means within and across universities by the question's category. The main findings were: (1) students in both universities performed consistently on each of the three categories in the order of algorithmic > LOCS > HOCS; (2) success on algorithmic/LOCS does not imply success on conceptual or HOCS questions. Our study supports the effort being made worldwide to integrate HOCS-oriented teaching strategies and conceptual teaching pedagogies within science education, particularly, wherever STES-oriented curriculum is involved.

Zuckerman, June T.

Strand 1 — Sun, 23 Apr, 1995 4:00 PM Monterey

Representations of an Osmosis Problem

A problem representation is the internal mental model that drives the solving process. Students commonly misrepresent science problems because their scientific knowledge is inaccurate and/or they associate objects in the problem statement with their intuitive ideas rather than with scientific principles. The purpose of this study was to analyze the representations, especially the misrepresentations, eighteen outstanding high school science students constructed for a problem about a typical osmometer-like system. The solvers thought aloud as they solved the problem and then explained their solvings. If they predicted that water moved into the funnel and attributed that movement to the concentration gradient and/or membrane permeability, I classified their representation as correct. Otherwise it was incorrect, i.e., a misrepresentation. Eleven representations were correct, although four were somewhat flawed and seven were incorrect. In fact, six of these seven misrepresentations were not even about osmosis. Instead, they seemed to derive from the solvers' intuitive ideas. With appropriate cues, teachers may be able to shift these solvers from an intuitive to a more scientific representation.

PART D

First Authors' Addresses

First Author's Addresses

Abell, Sandra K.	Purdue University, Department of Curriculum & Instruction, LAEB 4126, West Lafayette, IN 47907-1442.
Abraham, Michael R.	University of Oklahoma, Dept of Chemistry & Biochemistry, Norman, OK 73019.
Abrams, Eleanor D.	University of New Hampshire, Dept of Education, Morrill Hall, Durham, NH. 03824.
Adey, Philip	King's College London, Cornwall House, Waterloo Road, London SE18TX, UK.
Agard, Egberto	Universidad de Panamá, Panamá.
Akatugba, Avo H.	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Alexander, Patricia A.	Texas A & M University, Department of EDCI, College Station, TX 77843-4232.
Allen, William A.	University of Texas at Austin, 10926 Preston Trails Drive, Austin, TX 78747-1646.
Allen, Sue	850 Wilmington Road, San Mateo, CA 94402.
Allen, Nancy	University of Texas at Austin, Science Education Center EDB 340, Austin TX 78712.
Anderson, David	Kelvin Grove High School, 51 Bowd Parade, Wavell Heights, Australia, 4012.
Anderson, Linda M.	Michigan State University, 118 Erickson Hall, East Lansing, MI 48824-1034.
Anderson, Ronald D.	University of Colorado, CB249, Boulder, CO 80309.
Antony, Mary	17 Seward St No. 5, Saratoga Springs, NY 12866.
Appleton, Ken	Central Queensland University, Faculty of Education, Rockhampton, Australia, 4702.
Arambula-Greenfield, Teresa	University of Hawai'i, Women's Studies Program, 2424 Maile Way - Porteus 722, Honolulu, HI 96822.
Atwood, Ronald K.	University of Kentucky, 112 Taylor Building, Lexington, KY 40506.
Audet, Richard H.	Boston University, School of Education, 605 Commonwealth Ave, Boston, MA 02215.
Ayala, Nancy	Centro Profesional Panamericano, Cali, Colombia.
Backe, Kathrine A.	BSCS, 5415 Mark Dabling Blvd, Colorado Springs, CO 80918-3842.
Bailey, Bambi L.	University of Delaware, Department of Chemistry and Biochemistry, Newark, DE 19716.
Balling, John D.	Computer Service, Dickinson College, Carlisle, PA 17013.
Baker, Dale	Arizona State University, College of Education, Tempe, AZ 85287 1911.
Barba, Robertta H.	San Jose State University, College of Education, San Jose, CA 95192-0076.
Barden, Laura M.	University of Tennessee, 311 Claxton Education Addition, Knoxville, TN 37996-3400.
Barnea, Nitza	Technion, Dept. Education in Technology & Science, Haifa, Israel, 32000.
Barowy, William	Bolt Beranek & Newman Inc., 150 Cambridge Park Drive, Cambridge, MA 02140.
Barrera de Aragón, Maria	Pontificia Universidad Javeriana, Santafé de Bogotá, Colombia.
Barrow, Lloyd H.	University of Missouri, Southwestern Bell Science Ed Center, 108 Townsend Hall, Columbia, MO 65211.
Bartley, Anthony W.	Lakehead University, Faculty of Education, 955 Oliver Road, Thunder Bay, Canada, P7B 5E1.
Baumert, Jurgen	Institute for Science Education, University of Kiel, Olshausenstr. 62, Kiel, Germany, D 24098.
Becker, Joe	University of Illinois-Chicago, College of Education, Chicago, IL 60680.
Beeth, Michael	The Ohio State University, 253 Arps Hall, 1945 N. High Street, Columbus, OH 43210.
Bell, Philip	University of California at Berkeley, Tollman Hall, Berkeley, CA 94720.
Belzer, Sharolyn J.	University of Michigan, 1900 Parkwood Lane, #B103, Idaho Falls, MI 83401.
Ben-Chaim, David	Haifa University - Oranim, Dept of Science Education Chemistry, Kiryat Tivon, Israel, 36910.
Berg, Craig A.	University of Wisconsin, 323 Enderis Hall, Milwaukee, WI 53201.
Berger, Carl	University of Michigan, 610 East University, Ann Arbor, MI 48109-1259.
Berlin, Donna F.	The Ohio State University, National Center for Science Teaching and Learning, 1929 Kenny Road, Columbus, OH 43210.
Bernhardt, Elizabeth	The Ohio State University, 1945 N High, 249 Arps, Columbus, OH 43210.
Bianchini, Julie A.	Stanford University, 207 N Ceras, Stanford, CA 94305-3084.
Black, Kathie M.	University of Victoria, Faculty of Ed, Social and Natural Sciences, PO Box 3010, Victoria, Canada, V8W 3N4.
Black, Paul	King's College London, Cornwall House, Waterloo Road, London SE18TX, UK.
Bleicher, Robert E.	Queensland University of Technology, Centre for Maths Science Ed, Locked Bag No. 2, Redhill, Australia, 4059.
Bloom, Jeff	Acadia University, School of Education, Wolfville, Nova Scotia, Canada BOP 1X0.
Bodner, George	Purdue University, Dept of Chemistry, Purdue University, 1396 Physics Building, West Lafayette, IN 47907-1396.
Bolte, Claus	Institute for Science Education, University of Kiel, Olshausenstr. 62, Kiel, Germany, D 24098.
Bombaugh, Ruth	University of Michigan, SOE3112, Ann Arbor, MI 48109.
Boone, William J.	Indiana University, School of Education, Room 3068, Bloomington, IN 47405.
Borun, Minda	Franklin Institute Science Museum, 20th & Parkway, Philadelphia, PA 19103.
Boujaoude, Saouma	Department of Education, American University of Beirut, 850 Third Ave, New York, NY 10022.
Bowen, Craig	University of Southern Mississippi, Department of Chemistry & Biochemistry, Box 5043, Hattiesburg, MS 39406-5043.
Breen, Timothy J.	University of Michigan, 610 E. University, SEB 4109, Ann Arbor, MI 48109.
Briscoe, Carol	University of West Florida, 11000 University Parkway, Pensacola, FL 32514.
Brody, Michael	Montana State University, College of Education, Reid Hall, Bozeman, MT 59717.
Brown, David	University of Illinois, College of Education, Dept of Curric. & Instr., 1310 S. Sixth St, Champaign, IL 61820.
Brown, Fletcher	University of Montana, 121 LA Building, Curriculum & Instruction, Missoula, MT 59812-1054.
Brown, Sally	University of Stirling, Department of Education, Stirling, Scotland, FK9 4LA.
Browne, Ron	Georgia Southern University, Landrum Box 8083, Statesboro, GA 30460-5279.
Bullock, Linda D.	University of Texas at Austin, Science Education Center, EDP 340, Austin, TX 78712.
Bunderson, Eileen D.	Brigham Young University, 201 J MCKB, Provo, UT 84602.
Burger, Nikki	University of Victoria, Faculty of Ed, Social and Natural Sciences, PO Box 3010, Victoria, Canada, V8W 3N4.
Burke, Christopher	University of Illinois, Room 390, Education Building, Champaign, IL 61801.

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Burry-Stock, Judith A.	University of Alabama, College of Education, Box 870231, Tuscaloosa, AL 35487-0231.
Butler Kahle, Jane	Miami University - Ohio, 47 McGuffey Hall, Oxford, OH 45056.
Butts, David P.	The University of Georgia, Aderhold Hall, Athens, GA 30602.
Cabrera-Castro, Maria F.	Universidad Pedagógica Nacional, Santafé de Bogotá, Colombia.
Caggiano, Mary E.	Boston University, Dept of Science Education, 605 Commonwealth Avenue, Boston, MA 02215.
Camacho, Moisés	Interamerican University of Puerto Rico, Aguadilla Campus, Box 20,000, Aguadilla, Puerto Rico, 00605.
Campbell, James R.	St. John's University, 206 Marillac Hall, Jamaica, NY 11439.
Carnes, Nathan	Miami University, Project Discovery, 420 McGuffey Hall, Oxford, OH 45056-1693.
Caseau, Dana	Department of Counseling and Special Ed., CSU - Fresno, Fresno, CA 93740.
Castaño, Norma C.	Universidad Pedagógica Nacional, Santafé de Bogatá, Colombia.
Cavallo, Ann M. L.	The University of Oklahoma, Science Education Center, 820 Van Vleet Oval, Norman, OK 73019-0260.
Chandler, Frances Tate	San Jose State University, 1085 S. Livermore Avenue, Livermore, CA 94550-4812.
Chang, Ching-Kuch	National Changhua University, Paisa Village, Changhua, Taiwan, R O C 50058.
Charron, Elizabeth	Montana State University, Reid Hall, Bozeman, MT 59717.
Chevalier, Susan	Boise State University, Boise, ID.
Chin, Chi-Chin	National Museum of Natural Science, 1 Kuan Chen Rd, Taichung, Taiwan, R O C 40419.
Chiu, Mei-Hung	National Taiwan Normal University, Grad. Insti.of Sci. Ed. 88 Sec 4 Ting Chou Road, Taipei, Taiwan, ROC 11718.
Christensen, Clare	Queensland University of Technology, Centre for Maths & Science. Ed, Locked Bag No. 2, Red Hill, Australia, 4059.
Chyuan, Jong-Pyng M.	National Taipei Teachers College, Dept. of Science & Math Education, 134 Ho-ping E. Rd, Taipei, Taiwan, R O C 10659.
Clay, Samuel L.	Brigham Young University, 1005 SWKT, Dept of Psychology, Provo, UT 84602.
Clement, John	Scientific Reasoning Research Institute, 302 Hasbrouck, Box 33725, Amherst, MA 01003.
Cobern, William W.	Arizona State University West, 4701 W. Thunderbird Rd, PO Box 37100, Pheonix, AZ 85069-7100.
Cogan, Leland	Michigan State University, 414 Erickson Hall, East Lansing, MI 48824-1034.
Coleman, Sharon L.	Southeast Missouri State University, Chemistry Department, 900 Normal, Cape Girardeau, MO 63701.
Collins, Angelo	Florida State University, Science Education, Tallahassee, FL 32306.
Colombo de Cudmani, Leonor	Instituto de Fisica, Fac de Ciencias Exactas, Universidad Nacional de Tucuman, Tucuman, Argentina, 4000.
Cook, Julie	The Ohio State University - Lima, 420 D Galvin Hall, 4240 Campus Driva, Lima, OH 45804.
Cracolice, Mark S.	University of Montana, Department of Chemistry, Missoula, MT 59812.
Crawford, Barbara A.	The University of Michigan, Room 1323 SEB, 610 East University, Ann Arbor, MI 48109.
Crawley, Frank E.	East Carolina University, Dept of Science Education, 357 Flanagan Building, Greenville, NC 27858-4353.
Cronin, Patrick	Curtin University of Technology, SMEC, GPO Box U 1987, Perth, Australia, 6001.
Crow, Linda W.	Baylor College of Medicine, Division of School-based Programs, 1709 Dryden, Suite #519, Houston, TX 77030.
Cuevas-Arteaga, Cecilia	Universidad de Morelos, Mexico.
Cunningham, Christine M.	Cornell University, 100 Kennedy Hall, Ithaca, NY 14853.
Czerniak, Charlene M.	University of Toledo, College of Education, Toledo, OH 43600.
Dai, Mei-Fun Wang	Taipei Municipal Teachers College, Ai-Kao W. Rd, Taipei, Taiwan, R O C 100.
Damnjanovic, Arta	Miami University, Project Discovery, 420 McGuffey, Oxford, OH 45056.
Dana, Tom	Pennsylvania State University, Department of C & I, University Park, PA 16802.
Davis, Kathleen S.	University of Colorado - Boulder, 4949 Eisenhower Dr., Boulder, CO 80303.
Davis, Elizabeth A.	University of California at Berkeley, Tollman Hall, Berkeley, CA 94720.
Davis, Nancy T.	Florida State University, Science Education, Tallahassee, FL 32306.
de Castillo, Guadalupe T.	Universidad de Panamá, Panamá.
de Isaacs, Lydia	Universidad de Panamá, Panamá.
de Kidder, Francisca Garcia	Michigan State University, 212 Erickson Hall, Teacher Education Department, East Lansing, MI 48911.
de Samudio, Matilde	Universidad de Panamá, Panamá .
Delacôte, Goëry	Exploratorium, 3601 Lyon St, San Francisco, CA 94213.
Demastes, Sherry S.	University of Utah, Dept of Educational Studies, 139B Milton Bennion Hall, Salt Lake City, UT 84112.
Denning, Rebecca	Ohio State University, Center for Cognitive Science, 1961 Tuttle Park Place, Columbus, OH 43210.
Deru, David B.	The University of Georgia, Dept of Science Ed, Athens, GA 30602.
Desouza, Shireen J.M.	Georgia Southwestern College, Education Center, 800 Wheatley Street, Americus, GA 31709.
Destino, Thomas	University of California, Santa Cruz, CA.
Dickinson, Valarie	Washington State University, Dept of Elementary and Secondary Education, Pullman, WA 99164-2132.
Dickinson Bird, Mary	University of Maine, College Of Education, Orono, ME 04469.
Dierking, Lynn D.	Science Learning, Inc., 1310 Harbor Road, Annopolis, MD 21403.
Dillon, Justin	King's College London, Cornwall House, Waterloo Road. London SE18TX, UK.
Doherty, Cindy L.	Florida State University, 209 Carothers, Tallahassee, FL 32306.
Dooms, Patrick	Science Education Project, Box 46, PO Wits, 2050 Johannesburg, South Africa.
Doran, Rodney L.	State University of New York, 593 Baldy, Buffalo, NY 14260.
Dori, Yehudit J.	Department of Education, Technology and Science Technion, Haifa, Israel, 32000.
Dorman, Jeffrey P.	Australian Catholic University, PO Box 247, Everton Park, Australia, 4053.
Dorough, Donna K.	Pennsylvania State University, 163 Chambers Building, University Park, PA 16802.
Douma, Joost J.	IMPULS Science & Technology Center, Technologie Museum NINT, Telstraat 129, Netherlands, 1074VJ.
Duek, JodyLee E.	Dean's Office, UCLA School of Medicine, 12-138 CHS, 10833 LeConte, Los Angeles, CA, 90024.
Duffy, Maryellen	University of Massachusetts, Lowell, 17 Beacon St, Amesbury, MA 01913.
Duit, Reinders	Institute for Science Education, University of Kiel, Olshausenstr. 62, Kiel, Germany, D 24098.
Durham, Mary E.	North Carolina State Univ., Dept Maths & Science Education, 326 Poe Hall, Box 7801, Raleigh NC27695-7801.
Duschl, Richard A.	University of Pittsburgh, Forbes Quadrangle, Pittsburgh, PA 15260.

Dykstra, Dewey I. Jr	Boise State University, Boise, ID.
Edgington, Judith R.	University of Texas, Science Education Center,1701 Fawn Drive, Austin, TX 78741.
Edmondson, Katherine M.	Cornell University, College of Veterinary Medicine, SI014 Schurman Hall, Ithaca, NY 14853.
Ellis, James D.	BSCS, 5415 Mark Dabling Blvd, Colorado Springs, CO 80918-3842.
Enochs, Larry	University of Wisconsin-Milwaukee, CMSER, 269 Enderis Hall, POBox 413, Milwaukee, WI 53201.
Evans, Robert H.	Wake Forest University, PO Box 7266, Reynolda Station, Winston-Salem, NC 27109.
Fairbrother, Robert	King's College London, Cornwall House, Waterloo Road, London SE18TX, UK.
Falk, John H.	Science Learning Inc, 1310 Harbor Road, Annaopolis, MD 21403.
Farragher, Pierce	University of Victoria, Faculty of Ed., Dept of Social and Natural Sciences, PO Box 3010 , Victoria, Canada, V8W 3N4.
Feldman, Allan	University of Massachusetts, School of Education, 101A Furcolo Hall, Amherst, MA 01003.
Fetters, Marcia K.	University of North Carolina, Dept of C & I, College of Ed and Allied Professions, UNC Charlotte, NC 28223.
Finley, Sandra J.	University of Texas at Austin, Science Education Center, EDB 340, Austin, TX 78712.
Fisher, Robert L.	202 Collins Drive, Normal, IL 61761-2321.
Fleener, M. Jayne	University of Oklahoma, College of Education, Norman, OK 73019.
Flick, Lawrence B.	Oregon State University, Science and Mathematics Education, Weniger 263, Corvallis, OR 97331-6508.
Foley, Brian	University of California at Berkeley, Tollman Hall, Berkeley, CA 94720.
Fox, JoAnna	Georgia Institute of Technology, Center for Education in Science, Mathematics & Computing, Atlanta, GA 30332-0282.
Fraser, Barry J.	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Freeman, John G.	University of Michigan, SEB 1323, 610 E. University Avenue, Ann Arbor, MI 48109.
French, Jenice	Kansas State University, Bluemont Hall, Manhattan, KS 66502.
Friedman, Jeffrey S.	University of California at Berkeley, 4533 Tolman Hall, Berkeley, CA 94720.
Gabel, Dorothy L.	Indiana University, School of Education, Bloomington, IN 47405.
Gallagher, James J.	Michigan State University, Erickson Hall, East Lansing, MI 48824.
Gallard, Alejandro	Florida State University, Science Education, Tallahassee, FL 32306.
Garcia-Bravo, William	Universidad de Concordia, Montreal, Canada.
Gaskell, Jim	University of British Columbia, Faculty of Educatiuon, Vancouver, BC V6T124, Canada.
Gattis, Kenneth W.	North Carolina State University, Box 7105, Raleigh, NC 27695.
Gee, Carrie J.	Indiana University, Wright Education Building Rm 4202, 201 North Rose Ave, Bloomington, IN 47405-1006.
Gerber, Brian L.	University of Oklahoma,.Center for Energy Education, 510C Sarkey's Energy Center, Norman, OK 73019.
Germann, Paul J.	University of Missouri, 108 Townsend Hall, Columbia, MO 65211.
Gess-Newsome, Julie	University of Utah, Department of Education Studies, 307 Milton Bennion Hall, Salt Lake City, UT 84112.
Gibson, Adrienne	Cactus Shadows High School, Cave Creek, AZ 85331.
Giddings, Geoffrey J.	Curtin University of Technology, Faculty of Education, GPO Box U1987, Perth, Australia, 6001.
Gilmer, Penny	Florida State University, Department of Chemistry, DLC 216, Tallahassee, FL 32306.
Ginns, Ian	Queensland University of Technology, Locked Bag No. 2, Red Hill, Australia, 4059.
Ginossar, Shlomit	The Hebrew University of Jerusalem, Department of Science Education, Jerusalem, Israel 91904.
Glick, Judith G.	Oregon State University, Science and Math Ed Dept, Weniger Hall, Corvallis, OR 97331-4508.
Goldberg, Fred	San Diego State University, CRMSE, San Diego, CA 92120.
Good, Ron	Louisiana State University, College of Education, Baton Rouge, LA 70803.
Gore, Michael	Questacon, The National Science and Technology Centre, P.O.Box E28, Queen Victoria Terrace, Canberra, Australia 2600
Grewal, Joe	University of Victoria, Faculty of Ed, Social and Natural Sciences, PO Box 3010, Victoria, Canada, V8W 3N4.
Griffin, Janette	University of Technology, Sydney, PO Box 222, Lindfield, Australia, 2070.
Griffiths, Alan	Memorial University of Newfoundland, Department of C & I, St John's, Newfoundland, Canada, A1B 3X8.
Grimes, Katheryn	Gwendolyn Wooley Elementary School, 3955 Timberlake, Las Vegas, NV 89115.
Grynkewich, Linda C.	University of Georgie, Science and Education Department, 212 Aderhold Hall, Athens, GA 30602.
Guo, Chorng-Jee	National Changhua University of Education, Grad Inst.of Sc. Ed., College of Science, Taiwan, R O C 500.
Gustafson, Brenda J.	University of Alberta, Dept of Elementary Ed, 551 Education South, Edmonton, Canada, T6G 2G5.
Guy, Mark	University of North Dakota, Center for Teaching & Learning, Box 7189, Grand Forks, ND 58202.
Haack, Constance	University of Oklahoma, 10621 S. Quebec Ave, Tulsa, OK 74137.
Hackling, Mark W.	Edith Cowan University, Bradford St, Mount Lawley, Australia, 6050.
Hagelin, Linda B.	San Jose State University, College of Education, 20204 Blauer Dr., Saratoga, CA 95070-4308.
Hallenbeck, Mark	Michigan State University, 328 Erickson Hall, East Lansing, MI 48823.
Halloun, Ibrahim A.	Arizona State University, Department of Physics & Astronomy, Box 871504, Tempe, AZ 85287-1504.
Hameyer, Uwe	Institute for Science Education, University of Kiel, Olshausenstr. 62, Kiel, Germany, D 24098.
Hamid, Mohd L.	Universiti Sains Malaysia, Centre for Ed Technology and Media, Penang, Malaysia, 11800.
Hammond, Roselyn Brown	Morgan State University, 3502 N. Hilton Rd, Baltimore, MD 21215.
Haney, Jodi J.	Bowling Green State University, Bowling Green, KY.
Harrison, Allan G.	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Harrison, Christine	King's College London, Cornwall House, Waterloo Road, London SE18TX, UK.
Haury, David L.	The Ohio State University, 1929 Kenny Road, Columbus, OH 43210-1080.
Häussler, Peter	Institute for Science Education, University of Kiel, Olshausenstr. 62, Kiel, Germany, D 24098.
Hayes, Michael T.	University of Utah, 307 MBH, Salt Lake City, UT 84112.
Hazelwood, Constanza	Michigan State University, Erickson Hall, East Lansing, MI 48824.
Hedgepeth, David J.	The University of Alabama, Box 870231, Teacher Education, Tuscaloosa, AZ 35487.
Helms, Jenifer V.	Stanford University, 425 Alma #311, Palo Alto, CA 94301.
Henderson, David G.	Launceston College, Paterson Street, Launceston, Australia, 7250.
Henning, Elizabeth	Rand Afrikaans University, PO Box 524, Auckland Park, South Africa, 2006.

Henson, Stanley J.	Arkansas Tech University, Box 6862 ATU, Russellville, AR 72801.
Hestenes, David	Arizona State University, Box 871504, Tempe, AZ 85287-1504.
Hewson, Peter W.	University Wisconsin-Madison, Teacher Education, Madison, WI 53706.
Hildebrand, Gaell	University of Melbourne, Education - Alice Hoy Building, Parkville, Australia, 3052.
Hobden, Paul	University of Natal, CASME, King George V Avenue, Durban, South Africa, 4001.
Hoffman, Henrietta	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia 6001.
Hoffmann, Lore	Institute for Science Education, University of Kiel, Olshausenstr. 62, Kiel, Germany, D 24098.
Hofstein, Avi	Weizmann Institute of Science, Dept of Science Teaching, PO Box 26, Rehovot , Israel, 76100.
Holliday, William G.	University of Maryland, Department of C & I, College Park, MD 20742.
Holthuis, Nicole E.	Stanford University School of Education, 207N CERAS, Stanford, CA 94305-3084.
Hsiung, Chao-Ti	National Taipei Teachers College, 134 Ho-Ping E Rd, Sec. 2, Taipei , Taiwan, R O C 10659.
Hsiung, Tung-Hsing	National Taipei Teachers College, 134 Ho-Ping E Rd, Sec. 2, Taipei , Taiwan, R O C 10659.
Huang, Iris T.	National Kaohsiung Normal University, Kaohsiung , Taiwan, R O C 802.
Hudson, Terry	Sheffield Hallam University, Centre for Sc. Ed. Collegiate Crescent Campus, Sheffield, England, S10 2BP.
Hudson, Sharon P.	Morehead State University, 304 D Ginger Hall, Morehead, KY 40351.
Huffman, Douglas	University of Minnesota, Dept of Curriculum and Instruction, 150 Peik Hall, MN 55455.
Hug, William	Pennsylvania State University, 153 Chambers Building, University Park, PA 16802.
Huinker, DeAnn	University of Wisconsin, P.O. Box 413, Milwaukee, WI 53201.
Hurd, Paul DeHart	Stanford University, 549 Hilbar Lane, Palo Alto, CA 94303.
Hurst, Roy	University of Southern Mississippi, Southern Station Box 5087, Hattiesburg, MS 39406-50897.
Husén, Torsten	University of Stockholm, Institute of International Education, S-106 91, Stockholm, Sweden.
Hwang, Bao-tyan	Institute of Chemistry, National Taiwan Normal University, #88 Sec 5, Tinchow Rd, Taipei, Taiwan ROC , 11718.
Jackson, David F.	University of Georgia, Science Education Department, 212 Aderhold Hall, Athens, GA 30602-7126.
Jackson, Shari	University of Michigan, 610 East University, Ann Arbor, MI 48109-1259.
James, Robert K.	Texas A & M University, EDCI, College Station, TX 77843-4232.
Jarvis, Tina	Leicester University, School of Education, 21 University Road, Leicester, England, LE1 7RF.
Jasslavich, Sheila M.	Marist College, Division of Social & Behavioral Sciences, Dyson 327, Poughkeepsie, NY 12601.
Jeffries, Carolyn L.	2924 2nd St #6, Long Beach, CA 90803-5162.
Jegede, Olugbemiro	University of Southern Queensland, Distance Education Centre, Toowoomba, Australia, 4350.
Jensen, Murray	General College University of Minnesota, 368 Appleby Hall, 128 Pleasant St. SE, Minneapolis, MN 55455.
Johnson, Judith	University of Central Florida, College of Education, Orlando, FL 32816.
Johnson, Sandra	Texas Education Service Center, Region XIII, 604 East Covington, Austin, TX 78753.
Johnston, David	Curtin University of Technology, SMEC, GPO Box U 1987, Perth, Australia, 6001.
Johnston, Jane	The Nottingham Trent University, Clifton Hall, Clifton Village, Nottingham, United Kingdom, NG11 8NJ.
Jones, Leslie S.	The Ohio State University, 107 Plumb Hall, 2027 Coffee Road, Columbus, OH 43210.
Jones, Gail	University of North Carolina, CH# 3500, Chapel Hill, NC 27599-3500.
Jones, Loretta	University of Northern Colorado, College of Arts & Sciences, Dept of Chem & Biochem, Greeley, CO 80639.
Jungwirth, Ehud	The Hebrew University of Jerusalem, PO Box 12, Rehovot, Israel, 76-100.
Kali, Yael	Weizmann Institute of Science, Dept of Science Teaching, Rehovot, Israel, 76100.
Kamen, Michael	Auburn University, Department of Curriculum and Teaching, Auburn, AL 36849-5212.
Karunaratne, Sunethra	1401 G Spartan Village, East Lansing, MI 48823.
Kass, Heidi	University of Alberta, Dept of Sec. Education, 341 Education South, Edmonton, Alberta, Canada, T6G 2G5.
Kattmann, Ulrich	University of Oldenburg, POB 2503, D 26111 Oldenburg, Germany.
Keeves, John P.	Flinders University, School of Education, GPO Box 2100, Adelaide, 5001 Australia.
Keiffer-Barone, Susan	6978 Perthview Court, Cincinnati, OH 45244.
Keiny, Shoshana	Ben-Gurion University of the Negev, Beer Sheva, Israel.
Keller, Jill L.	University of Arizona, College of Medicine, 2613 W. Calle Paraiso, Tucson, AZ 85745.
Kelly, Gregory	University of California, Department of Education, Santa Barbara, CA 93106-9490.
Kermis, William J.	Southwestern Oklahoma State University, 100 Campus Drive, Weatherford, OK 73096-3098.
Kesner, Miri	Weizmann Institute of Science, Dept of Science Teaching, PO Box 26, Rehovot , Israel, 76100.
Keys, Carolyn W.	Georgia State University, MSEIT Department, University Plaza, Atlanta, GA 30303-3083.
Klapper, Michael H.	Ohio State University, National Center Science Teaching/Learning, 1929 Kenny Road, Columbus, OH 43210.
Knight, Stephanie L.	11810 Pebbleton Drive, Houston, TX 77070.
Koballa, Thomas	University of Georgia, Aderhold Hall, Athens, GA 30602.
Kokoski, Teresa M.	University of New Mexico, Student Services Center B-30, Alburquerque, NM 87131-1231.
Komorek, Michael	Institute for Science Education, University of Kiel, Olshausenstr. 62, Kiel, Germany, D 24098.
Koran, John J., Jr	University of Florida , Museum of Natural History, Norman Hall, 258 College of Education, Gainesville, FL 32611.
Krajcik, Joseph S.	University of Michigan, School of Education, Ann Arbor, MI 48109-1259.
Kuiper, Wilmad	University of Twente, Faculty of Education Science and Technology., PO Box 217, 7500 AE Enschede, The Netherlands.
Kumar, David	Florida Atlantic University, 2912 College Ave, Davie FL 33314.
Kurth, Lori A.	Michigan State University, Erickson Hall, East Lansing, MI 48824.
Kyhl, Caroline S.	University of St. Thomas, 2115 Summit Ave, CHC 131, St Paul, MN 55105-1096.
Larson, Jane O.	PSC 78 Box 4321, APO AP, CO 96326-4321.
Lavoie, Derrick R.	University of Northern Iowa, Department of Biology, Cedar Falls, IA 50614-0421.
Lawrence, Chris	University of Iowa, 470 Van Allen Hall, Iowa City, IA 52242.
Lawson, Anton E.	Arizona State University, Department of Zoology, Tempe, AZ 85287.
Lederman, Norman G.	Oregon State University, Science and Mathematics Education, Weniger Hall 237, Corvallis, OR 97331.

BEST COPY AVAILABLE

Lee, Kwan-Min	University of the Witwatersrand, College of Science, PO WITS 2050, Johannesburg, South Africa.
Lehman, James D.	Purdue University, 1442 LAEB, West Lafayette, IN 47907-1442.
Lennon, Alan	University of Northern Colorado, Ross Hall, Biology Dept, Greeley, CO 80639.
Lewis, Eileen	University of California at Berkeley, Tollman Hall, Berkeley, CA 94720.
Lu, Bor-Wei	Teachers Inservice Training Center of Taipei Municipality , 2, Cheng Kow St., Yang-Ming Shan, Taipei, Taiwan R.O.C.
Lum, Siew-Bee	University of Brunei Darussalam, Faculty of Education, Bandar Seri Begawan, Brunei Darussalam.
Lin, Huann-Shyang	National Kao-Hsiung Normal University, Department of Chem., 116 Ho-Ping 1st Road, Kao-Hsiung, ROC, 802.
Lin, Sheau-Wen	Apt No. 318,20 Bog Road, Concord, NH 03303.
Lindauer, Ivo E.	University of Northern Colorado, Dept of Biological Sciences, Greeley, CO 80639.
Linn, Marcia	University of California at Berkeley, Tollman Hall, Berkeley, CA 94720.
Liu, Chin-Tang	University of Iowa, Science Education Centre, 761 Van Allen Hall, Iowa City, IA 52242.
Louts, James	Metropolitan State College of Denver, Denver, CO.
Lomask, Michal	CT State Department of Education, 165 Capitol, Hartford, CT 06145.
Lord, Thomas R.	Indiana University of Pennsylvania, Weyandt Hall, Indiana, PA 15705.
Lorsbach, Tony	University of Alabama, Institute for Science Education, Morton Hall Room 122, Huntsville, AL 35899.
Louden, William	Edith Cowan University, Pearson St, Churchlands, Australia, 6018.
Loving, Cathleen C.	Texas A & M University, Department of EDCI, College Station, TX 77843.
Lowitts, Barbara E.	National Science Foundation, 4201 Wilson Bldv, Arlington, VA 22230.
Lowery Bretz, Stacey	University of California, Department of Chemistry, Berkeley, CA 94720.
Lowrey, Kirsten	Purdue University, Dept of Chem.& Physics 1396 Physics Building, West Lafayette, IN 47907-1396.
Lubezky, Aviva	Haifa Univerity Oranim, Dept of Science Education, Kiryat Tivon, Israel, 36910.
Lucas, Keith B.	Queensland University of Technology, Locked Bag 2, Red Hill, Australia, 4059.
Lumpe, Andrew T.	University of Toledo, Snyder Memorial Hall, Toledo, OH 43606-3390.
Lunetta, Vincent	Pennsylvania State University, College of Education, University Park, PA 16802.
Lynch, Sharon J.	George Washington University, 2134 G Street NW, Washington, DC 20052.
MacIsaac, Dan	Purdue University, Purdue University Dept of Physics, 1396 Physics Building, West Lafayette, IN 47907-1396.
MacKinnon, Allan	Simon Fraser University, Faculty of Education, Burnaby, Canada, V5A 1S6.
Magnusson, Shirley	University of Michigan, School of Education, 610 E. University Ave, 1323 SEB, Ann Arbor, MI 48109-1259.
Maor, Dorit	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Marencik, Joseph	Settler Heights High School, 5100 Rockhill Road, 15911 Aldersyde Drive, OH 44129.
Mariani, Maria C.	São Paulo University, Edificio Principal, ALA II Instituto de Fisica USP, Caixa Postal 20516, Brazil, CEP 01452-990.
Marion, Scott F.	University of Colorado, School of Education, Campus Box 249, University of Colorado, Boulder, CO 80309-0249.
Marlow, Michael P.	University of Colorado at Denver, School of Education, PO Box 173364, Denver, CO 80217-3364.
Marlow, Stacey E.	University of Hawaii at Manoa, 1776 University Avenue, Honolulu, HI 96822.
Martinello, Marian L.	University of Texas at San Antonio, 6900 N Loop , 1604 W, San Antonio, TX 78249.
Martinez, Michael E.	University of California, Irvine, Department of Education, Irvine, CA 92717-5500.
Mason, Diana	The University of Texas, Dept of Chemistry and Biochemistry, Wel 3.140 A5300, Austin, TX 78712-1167.
Mastrilli, Thomas M.	University of Pittsburgh, 4B14 Forbes Quadrangle, Dept of Instruction and Learning, Pittsburgh, PA 15260.
Mata-Toledo, Ramon A.	Instituto Tecnológico de Apizaco, Apizaco, Mexico.
Matson, John O.	San Jose State University, One Washington Square, San Jose, CA 95192-0100.
Matthews, Michael R.	University of New South Wales, School of Education, Kensington, Australia 2033.
Mattson, Sue	Harvard-Smithsonian Center for Astrophysics, 60 Garden St MS-82, Cambridge, MA 02138.
Mayer, Victor J.	The Ohio State University, Department of Education Studies, Columbus, OH 43210.
Mayer, Jürgen	University of Kiel, Institute for Science Education, O[illegible]hausenstrasse 62, Kiel, Germany, 24098.
Mayer-Smith, Jolie A.	University of British Columbia, Dept of Curriculum Studies, Vancouver, BC V6T 1Z4, Canada.
McClafferty, Terence P.	Curtin Universityof Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
McConney, Andrew A.	Western Michigan University, The Evaluation Center, Kalamazoo, MI 49008-5178.
McDaniel, Patrice	University of Georgia, Science Education Department, 212 Aderhold Hall, Athens, GA 30602-7126.
McElroy, Keith	University of Kentucky, 335 Dickey Hall, Curriculum and Instruction, Lexington, KY 40506-0017.
McGinn, Michelle K.	Simon Fraser University, Faculty of Education, Burnaby, Canada, V5A 1S6.
McGinnis, Randy	University of Marvland, Science Teaching Center, 2226 Benjamin Bldg, MD 20742.
McGlamery, Sheryl	University of Northern Colorado, Department of Biological Sciences, Greeley, CO 80639.
McMahon, Maureen M.	University of Marvland, 2226 Benjamin Bldg, College Park, MD 20742.
McRobbie, Campbell J.	Queensland University of Technology, Centre for Maths & Science. Ed, Locked Bag No. 2, Red Hill, Australia, 4059.
Mdletshe, Khumbulani D.	Science Education Project, Box 46, PO Wits, 2050, Johannesburg, South Africa.
Melear, Claudia T.	East Carolina University, Room 357 Flanagan, Dept of Sc. Ed., 404 Westhaven Road, Greenville, NC 27834.
Moje, Elizabeth B.	The University of Utah, Graduate School of Education, 370 Milton Bennion Hall, Salt Lake City, UT 84112.
Molina, Fernando	Pontificia Universidad Javeriana, Santafé de Bogotá, Colombia.
Moon, Barbara	Simon Fraser University, Faculty of Education, Burnaby, Canada, V5A1S6.
Moore, Richard W.	Miami University, 301 McGuffey Hall, Oxford, OH 45056.
Moore, Jacquelyn J.	East Carolina University, Dept of Science Education, Greenville, NC 27858-4353.
Morais, Ana M.	University of Lisbon, School of Sciences, Campo Grande C1 - 2, Department of Education, Portugal, 1700.
Moreira, Marco A.	Instituto de Fisica UFRGS, Caixa Postal 15051 Campus do Vale, 91501-970 Porto Alegre, RS, Brazil.
Moscovici, Hedy	Western Washington University, Department of Biology, Bellingham, WA 98225-9060.
Mulholland, Judith	Australian Catholic University, PO Box 247, Everton Park, Australia 4053.
Murfin, Brian	Queens College: City University of NY, Powdermaker Hall 194, 65 - 30 Kissena Boulevard, Flushing, NY 11367.
Naidoo, Sharadh	University of the Witwatersrand, Physics Dept, Private Bag 3, PO WITS, Johannesburg, South Africa, 2050.

Nakhleh, Mary B.	Purdue University, 1393 Brown Bldg, West Lafayette, IN 47907-1393.
Navarro, Estela	Centro Latinoamericano de Investigación, Educativa, IBM de Mexico, Mexico,
Nelson, Barbara	Colorado State University, Colorado.
Nesbit, Catherine R.	University of North Carolina at Charlotte, Dept. of Curriculum and Instruction, Charlotte, NC 28223.
Nuz, Mansoor	Universidad de Oriente, Apartado Postal 90,, Cumana, Estado Sucre, Venezuela.
Nichols, Sharon E.	University of Texas, Science Ed Center EDB 340, Austin, TX 78712.
Nicolaos, Valanides	University of Cyprus, Dept of Education, PO Box 537, Nicosia, Cyprus.
Nieswandt, Martina	University of Kiel, Institute for Science Education, Olshausenstr 62, Germany, D-24098.
Norman, Obed	Washington State University, Science Education, 1812 East McLoughlin Blvd, Vancouver, WA 98663-3597.
Norman, Katherine	University of Texas, Education Department, 80 Fort Brown, Brownsville, TX 78520.
Norris, Stephen P.	Memorial University of Newfoundland, St. John's, Newfoundland, Canada, A1B 3X8.
Novak, Joseph D.	Cornell University, Dept of Education, 421 Kennedy Hall, Ithaca, NY 14853.
O'Rafferty, Maureen H.	Rutgers University, L & T, Graduate School of Education, 10 Seminary Place, New Brunswick, NJ 08903.
O'Sullivan, Kathleen A.	San Francisco State University, Dept of Secondary Education, 1600 Holloway Ave, San Francisco, CA 94132.
Odom, Louis	University of Missouri-Kansas City, 5100 Rockhill Road, 319 School of Education, Kansas City, MO 64110.
Odubunmi, Emmanuel O.	Lagos State University, OJO, Dept of Curriculum Studies, Faculty of Education, PMB 1087, Nigeria.
Ogbu, John	University of California at Berkeley, Dept of Anthropology, 232 Kroeber Hall, Berkeley, CA 94720.
Oka, Evelyn	Michigan State University, 444 Erickson Hall, East Lansing, MI 48824-1034.
Okebukola, Peter	Lagos State University, Faculty of Education, PMB 1087, APAPA Lagos, Nigeria,
Olsen, Timothy P.	University of Wisconsin-Madison, 1331 E. Johnson St, Madison, WI 53703-1707.
Orion, Nir	Weizmann Institute of Science, Dept of Science Teaching, PO Box 26, Rehovot, Israel, 76100.
Orpwood, Graham	York University, Faculty of Education, 4700 Keele St, North York, Canada, M3J 1P3.
Orquiza de Carvalho, Lizete M.	Faculdade de Engen.de Ilha Solteira, Av. Brasil Cntr.:56 - CP 31, Ilha Solteira, São Paulo, Brazil, 15378-000.
Ostrander, Ray	Andrews University, Berrien Springs, MI.
Ottevanger, Wout	The Instant Project, P/Bag 12027, Windhoek, Namibia.
Pacca, Jesuina L.	Instituto de Fisica, Universidade de São Paulo, Caixa Postal 20516, São Paulo, Brazil, 01452-990.
Pachón, Ernesto	Pontificia Universidad Javeriana, Santafé de Bogotá, Colombia.
Palmer, Amy B.	Indiana University, 3008 W W Wright Educaton, Bloomington, IN 47405-1006.
Pankiewicz, Philip R.	SUNY College , Bowers Hall, PO Box 2000, Cortland, NY 13045.
Pankratius, William J.	University of Las Vegas, 4905 Maryland Pkwy, Las Vegas, NV 89154-3005.
Pardo, Luz B.	Pontificia Universidad Javeriana, Santafé de Bogotá, Colombia.
Park, Sung Hye	Pennsylvania State University, 163 Chambers Bldg, University Park, PA 16802.
Parke, Helen	East Carolina University, 311 Flanagan Bld, Greenville, NC 27858.
Parker, Dawn	Texas A & M University, Department of EDCI, College Station, TX 77843.
Parker, Lesley H.	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Parsons, Sharon	San Jose State University, College of Educaton, One Washington Square, San Jose, CA 95192-0074.
Peasley, Kathleen L.	Michigan State University, 118 Erickson Hall, East Lansing, MI 48824-1034.
Peiffer, Bernadette M.	SciTrek, 395 Piedmont Ave NE, Atlanta, GA 30308.
Pesa, Marta	Instituto de Fisica, Fac de Ciencias Exactas, Universidad Nacional de Tucuman, Tucuman, Argentina, 4000.
Petrosino, Anthony J.	Vanderbilt University, Box 45, Peabody College, Nashville, TN 37203.
Phillips, Linda M.	Memorial University of Newfoundland, Faculty of Education, St. John's, Newfoundland, Canada, A1B 3X8.
Phillips, Denis	Stanford University, School of Education, Palo Alto, CA 94305.
Pirkle, Sheila	Louisiana State University, Peabody Hall, Baton Rouge, LA 70803-4707.
Plucker, Jonathan A.	The University of Virginia, Curry School of Education, Ruffner Hall, Emmet St, Charlottesville, VA 22903.
Pollard, Rebecca J.	Texas A & M University, Department of Educational Psychology, College Station, TX 77843-4225.
Powell, Richard R.	Texas Tech University, College of Education, Lubbock, TX 79409.
Pyle, Eric J.	University of Georgia, 212 Aderhold Hall, Athens, , GA 30602.
Ralston, Susan	University of Michigan, SOE3112, Ann Arbor, MI 48109.
Reap, Melanie A.	The University of Oklahoma, 820 Van Vleet Oval, Norman, OK 73019.
Reinhold, Peter	Institute for Science Education - IPN, University of Keil, Olshausenstrasse 62, Kiel, Germany, D-24098.
Rennie, Léonie	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Reyes-Garcia, Carlos A.	Instituto Tecnológico de Apizaco, Apizaco, Mexico.
Reyes-Herrera, Lilia	Florida State University, Carothers Hall, Tallahassee, FL 32306.
Rice, Diana C.	University of South Carolina-Aiken, 171 University Parkway, Aiken, SC 29801.
Richardson, Lon	Northern Kentucky University, School of Education, Nunn Drive, Highland Heights, KY 41040.
Richmond, Gail	Michigan State University, Dept Teacher Education, 330 Erickson Hall, East Lansing, MI 48824.
Riggs, Iris M.	California State University -San Bernardino, School of Education, San Bernardino, CA 92407.
Riley, Dana	Miami University, Project Discovery, 420 McGuffey Hall, Oxford, OH 45056.
Riley, Joseph P.	The University of Georgia, 212 Aderhold Hall, Athens, GA 30602.
Rillero, Peter	Arizona State University West, 4701 W. Thunderbird Road, PO Box 37100, Pheonix, AZ 85069-7100.
Ritchie, Stephen M.	James Cook University, School of Education, Townsville, Australia, 4811.
Robeck, Ed	University of British Columbia, Dept of Curriculum Studies, 2125 Main Mall, Vancouver, Canada, V6T 1Z4.
Robinson, Scott	Florida State University, Science Education Program, 209 Carothers Hall, Tallahassee, FL 32306-3032.
Rodriguez, Alberto J.	University of Wisconsin - Madison, Dept. of Curriculum & Instruction, 225 North Mills St, Madison, WI 53706-1795.
Rodriguez-Munoz, Marisol	The Ohio State University, The National Center for Science Teaching and Learning, 1929 Kenny Road, Columbus, OH 43210.
Roeber, Edward D.	Council of Chief State School Officers, 1664 Algoma Dr, Okemos, MI 48864.
Rogers, Laura N.	University of North Carolina , 601 S. College Road, Wilmington, NC 28403-3297.

BEST COPY AVAILABLE

Ron, Salit	Department of Education, Technology and Science, Technion, Haifa, Israel, 32000.
Rop, Charles	Michigan State University, 216 Erickson Hall, East Lansing, MI 48824-1034.
Roth, Wolff-Michael	Simon Fraser University, Burnaby, Canada, V5A 1S6.
Roth, Kathleen J.	Michigan State University, Erickson Hall, East Lansing, MI 48824-1034.
Rowell, Patricia M.	University of Alberta, Dept of Elem. Educ., 551 Education South, Uni. of Alberta, Edmonton, Canada, T6G 2G5.
Roychoudhury, Anita	Miami University of Ohio, 1601 Peck Boulevard, Hamilton, OH 45011.
Ruiz-Primo, Maria A.	University of California at Santa Barbara, Santa Barbara, CA.
Rye, James A.	Pennsylvania State University, 165 Chambers Building, University Park, PA 16802.
Ryu, Tae	Sophia University, 7-1 Kioicho, Chiyoda-ku, Tokyo, Japan.
Said, Safian	University of Massachusetts, College of Education, 1 University Avenue, Lowell, MA 01854.
Salmi, Hannu S.	University of Vassa, The Finnish Science Centre, Raastuvankatu 31, SF 65100, Vassa, Finland, FIN-01300 VANDA.
Sanders, Jo	City University of New York, Graduate Center, 25 West 43 St, Suite 400, New York, NY 10036.
Scharmann, Lawrence C.	Kansas State University, 247 Bluemont Hall, 1700 Anderson Avenue, Manhattan, KS 66506-5313.
Schauble, Leona	University of Wisconsin - Madison, Dept. of Curriculum & Instruction, 225 North Mills St, Madison, WI 53706-1795.
Schmidt, Hans-Jürgen	University of Dortmund, Dept of Chemistry, Otto-Hahn-Str. 6, 44221 Dortmund, Germany.
Schmidt, William H.	Michigan State University, 216 Erickson Hall, East Lansing, MI 48824-1034.
Schoneweg, Cristine	Pennsylvania State University, 153 Chambers Building, University Park, PA 16802.
Schriver, Marti	Georgia Southern University, Middle Grades Ed LB8134, Statesboro, GA 30460 8134.
Segal, Gilda	University of Technology, Sydney, Kuring-gai Campus, PO Box 222, Lindfield, Australia, 2070.
Settlage, John Jr	Cleveland State University, 1319 Rhodes Tower, Cleveland, OH 44115.
Sharp, Lynn	California State University, 800N State College Blvd, Fullerton, CA 92634.
Shaw, Jerome M.	Far West Laboratory, 730 Harrison St, San Francisco, CA 93107-1242.
She, Hsiao-Ching	National Taiwan Normal University, Science Education Center, 88 Sec. 4 Ting-Chou Rd, Taipei, Taiwan, R O C.
Shepardson, Daniel P.	Purdue University, Dept. C & I, 1442 LAEB, West Lafayette, IN 47907-1442.
Sheppard, Judith	Decker Elementary School, 1655 Decker Road, Walled Lake, Oakland County, CA 48390.
Sherman, Twyla G.	Wichita State University, Wichita, KY.
Sherwood, Robert D.	Peabody College of Vanderbilt University, Box 330, Nashville, TN 37203.
Shokere, Luke	Midwest S Health Sciences Program, 608 N 18th Street, Kansas City, KS 66102.
Shroyer, Gail	Kansas State University, Bluemont Hall, Manhattan , KS 66506-5313.
Shymansky, James A.	University of Iowa, 77 Van Allen Hall, Iowa City, IA 52242.
Simmons, Patricia	University of Georgia, Aderhold Hall, Athens, GA 30602.
Slater, Timothy F.	Pittsburg State University, College of Arts and Sciences, Pittsburg, KS 66762.
Smith, Mike U.	Mercer University School of Medicine, 857 Orange terrace, Macon, GA 31201.
Smith, Edward L.	Michigan State University, 328 Erickson Hall, East Lansing, MI 48823.
Smith, R. Timothy	Michigan State University, 243 Erickson Hall, East Lansing, MI 48824.
Sode, John R.	North Dakota State University, 155 Home Economics Building, Fargo, ND 58105.
Soloway, Elliot	University of Michigan, 610 East University, Ann Arbor, MI 48109-1259.
Spiegel, Sam	Florida State University, 209 MCH Tallahassee, FL 32306.
Spiller, Richard	School District #22, Vernon, British Colombia, Canada, V8W3N4.
Spitulnik, Michele W.	University of Michigan, 406N. State Street, #1, Ann Arbor, MI 48104.
Spitulnik, Jeff	University of Michigan, 610 East University, Ann Arbor, MI 48109-1259.
Stark, Rae	University of Strathclyde, Faculty of Education, Jordanhill Campus, 76 Southbrae Drive, Glasgow, Scotland, G13 1PP.
Stoddart, Trish	University of California, Santa Cruz, CA.
Stratford, Steve	University of Michigan, 610 East University, Ann Arbor, MI 48109-1259.
Streveler, Ruth	Colorado School of Mines, Student Support Services, Golden, CO 80401.
Stubbs, Harriett	North Carolina State University, 1509 Varsity Dve, Raleigh, NC 27606.
Stuessy, Carol L.	Texas A & M University, Department of EDCI, College Station, TX 77843.
Suarez-Gómez, Alfonso	Pontificia Universidad Javeriana, Santafé de Bogotá, Colombia.
Sullivan, Sherry	Butler University, 4600 Sunset Avenue, Indianapolis, IN 46208.
Sunal, Dennis W.	The University of Alabama, Department of Education, Box 870231, Tuscaloosa, AL 35487-0231.
Sunbury, Susan E.	Boston University, 10 Emerson Place #11C, Boston, MA 02114.
Suzuki, Mariko	University of California Berkeley, Tolman Hall, Berkeley, CA 94720.
Svec, Michael T.	Rockhurst College, 1100 Rockhurst Rd, Kansas City, KS 64110-2561.
Sykes, Gary	Michigan State University, 414 Erickson Hall, East Lansing, MI 48824-1034.
Talsma, Valerie L.	University of Michigan, 1323 School of Education, 610 E, Ann Arbor, MI 48109-1259.
Tamir, Pinchas	The Hebrew University of Jerusalem, Department of Science Education, Jerusalem, Israel 91904.
Taylor, Marilyn	Metropolitan State College of Denver, Denver, CO.
Taylor, Peter C.	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Thiele, Rodney B.	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Thomas, Julie	University of Lincoln, 118 Henzlik Hall, Lincoln, NE 68588-0355.
Thomas, Jeff A.	University of Southern Mississippi, Box 5087, Hattiesburg, MS 39406.
Thomas, Ray	Argonne National Laboratory, Division of Educational Programs, 9700 South Cass Avenue, Argonne, IL 60439.
Thoresen, Carol W.	Montana State University, STEP Project, 401 Linfield Hall, Bozeman, MT 59717.
Tippins, Deborah	University of Georgia, 212 Aderhold Hall, Athens, GA 30602.
Tobin, Kenneth	Florida State University, 209 Carothers Hall, Tallahassee, FL 32306-3032.
Tomanek, Debra	North Dakota State University, SU Station, Box 5517, Fargo, ND 58105-5517.
Toolin, Regina	University of Wisconsin-Madison, Dept of Curriculum and Instruction, 225 North Mills St, Madison, WI 53706.

Treagust, David F.	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Trowbridge, John	Southeastern Louisiana University, Dept of Teacher Education, SLU 749, Hammond, LA 70402.
Trumbull, Deborah J.	Cornell University, Department of Education, 426 Kennedy Hall, Ithaca, NY 14853.
Tuan, Hsiao-Lin	National Changhua University of Ed, Graduate Inst of Science Ed, Taiwan, R O C.
Tucker, Gary R.	Texas A & M University, Department of EDCI, College Station, TX 77843.
Tuss, Paul	Argonne National Laboratory, Division of Educational Programs, 9700 South Cass Avenue, Argonne, IL 60439.
Uyeda, Steven M.	North Hollywood High School Zoo Magnet Ctr, 5231 Colfax Ave, North Hollywood, CA 91411.
Valero, Michel	Universidad del Valle, Cali, Colombia.
Van Zee, Emily H.	University of California , 4533 Tolman Hall, Berkeley, CA 94720.
Varelas, Maria	University of Illinois-Chicago, College of Education, Chicago, IL 60680.
Varrella, Garry	University of Iowa, Van Allen Hall, Iowa City, IA 52242.
Viggiano, Elizabeth A.	Florida State University, 209 Carothers Hall, Tallahassee, FL 32306-3032.
Vitale, Michael R.	East Carolina University, School of Education, ECU, Greenville, NC 27858.
Vopava, Judy	University of Iowa, Van Allen Hall, Iowa City, IA 52242.
Wade, Philip	Oregon State University, Dept of Geoscience, Wilkinson Hall #104, Corvallis, OR 97331.
Walberg, Herbert J.	University of Illinois at Chicago, College of Education, 522 North Euclid Avenue, Oak Park, IL 60302.
Waldrip, Bruce G.	Curtin University of Technology, Faculty of Education, GPO Box U1987, Perth, Australia, 6001.
Wallace, John	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Wandersee, Jim	Louisiana State University, Room 223-F Peabody Hall, Baton Rouge, LA 70803.
Watson, Scott B.	East Carolina University, Department of Science Education, Greenville, NC 27858-4353.
Watters, James	Queensland University of Technology, Centre for Maths & Science. Ed, Locked Bag No. 2, Red Hill, Australia, 4059.
Weiss, Iris	Horizon Research Inc., 111 Cloister Court, Suite 220, Chapel Hill, NC 27514.
Welicker, Miriam	Technion, Dept of Education in Tech. and Science, Haifa, Israel, 32000.
Weller, Herman G.	University of Maine, College Of Education, Orono, ME 04469.
Wesso, Iona	Pennsylvania State University, Department of Education, Chambers Building, University Park, PA 16802.
Westbrook, Susan	North Carolina State University, Dept of Mathematics and Science Education, Box 7801, Raleigh, NC 27695-7801.
White, Barbara Y.	University of California , School of Education, 4533 Tolman Hall, EMST, Berkeley, CA 94721.
White, Robyn	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Whitworth, Joan M.	University of Colorado, School of Education, Boulder, CO 80309.
Wiggins, John R.	Georgia Institute of Technology, Center for Education in Science, Mathematics & Computing, Atlanta, GA 30332-0282.
Wildy, Helen	Curtin University of Technology, SMEC GPO Box U1987, Perth, Australia, 6001.
Willhite, K.T.	Lewis-Clark State College, Spalding Hall 302, 500 8th Avenue, Lewiston, ID 83501-2698.
Williamson, Vickie M.	Illinois State University, Campus Box 5960, CeMaST, Normal, IL 61790-5960.
Wilson, Julie L.	University of Arizona, 735 Education, Teaching and Teacher Education, Tucson, AZ 85721.
Wong, E. David	Michigan State University, 444 Erickson Hall, East Lansing, MI 48824-1034.
Wood, David A.	Secondary Education Authority, 27 Walters Drive, Osborne Park, Australia, 6017.
Woodin, Terry	National Science Foundation, 4201 Wilson Bvd Room 835, Arlington , VA 22230.
Woods, Corey S.	Kansas State University, 219 Bluemont Hall, Manhattan, KS 66506.
Woods, John D.	Edith Cowan University, Faculty of Education, 2 Bradford Street, Mount Lawley, Australia, 6050.
Woolnough, Brian E.	University of Oxford, 15 Norham Gardens, Oxford, OX2 6PY, U.K.
Wright, Emmett	Kansas City University, College of Education, Kansas City, KS 66102
Wynne, Cynthia F.	University of Wisconsin-Madison, 225 N. Mills St, Room 226E, Madison, WI 53706.
Yager, Robert E.	University of Iowa, Van Allen Hall, Iowa City, IA 52242.
Yeany, Russell	University of Georgia, 212 Aderhold Hall, Athens, GA 30602.
Yeroslavski, O.	Department of Education, Technology and Science Technion, Haifa, Israel, 32000.
Yore, Larry D.	University of Victoria, Dept of Social and Natural Sciences, PO Box 3010, Victoria, Canada, V8W 3N4.
Young, Deidra J.	Curtin University of Technology, SMEC, GPO Box U1987, Perth, Australia, 6001.
Yu, Shu-Mey	National Taichung Teachers College, 28 Tai-Yuan S. 2nd St. Taichung, Taiwan, R O C 404.
Zadnik, Mario G.	Curtin University of Technology, Dept. of Applied Physics, GPO Box U 1987, Perth. Australia, 6001.
Zandvliet, David B.	Faculty of Education, University of Victoria, Victoria, Canada, V8W3N4.
Zeidler, Dana L.	University of Massachusetts Lowell, Science Education, College of Education, Lowell, MA 01854.
Zietsman, Aletta	Wits University, Physics Department, Private Bag 3 PO Wits, Johannesburg, South Africa, 2050.
Zohar, Anat	Dept of Science and Technology Education, Technion, Haifa, Israel 32000.
Zoller, Uri	Haifa University - Oranim, Dept of Science Education, Kiryat Tivon, Israel, 36910.
Zuckerman, June T.	SUNY - New Paltz, Department of Secondary Education, Old Main 204 , New Paltz, NY 12561-2499.

PART E

Participant Index

(First Authors, Symposium Participants, Presiders and Discussants)

Participant Index

Abegg, Gerald	Sun	2.45PM	Portola						
Abell, Sandra	Sun	8.30AM	Washtn						
Abraham, Michael	Sun	8.30PM	Suite 2625						
Abrams, Eleanor	Sun	8.30PM	Monterey	Sun	4.00PM	Oregon			
Adey, Philip	Sun	4.00PM	Emerald	Mon	10.30AM	GoldRhB			
Agard, Egberto	Sun	7.00PM	Explrm	Tue	1.00PM	Calfn			
Ahlgren, Andrew	Sat	7.00PM	Crystal						
Aiello, Michael	Tue	8.30AM	Suite 2601						
Akatugba, Ayo	Sat	8.30PM	Emerald						
Alexander, Patricia	Tue	8.30AM	GoldRhA						
Allen, William	Mon	10.30AM	Portola						
Allen, Sue	Sun	10.30AM	Portola	Mon	8.30AM	Nevada			
Allen, Nancy	Mon	10.30AM	Oregon						
Altschuld, James	Sun	1.00PM	Suite 2601						
Anderson, David	Sun	8.30AM	Calfn						
Anderson, Linda M.	Sun	1.00PM	Calfn						
Anderson, Ronald	Mon	10.30AM	GoldRhA	Tue	2.30PM	GoldRhB			
Antony, Mary	Sat	7.00PM	Monterey						
Appleton, Ken	Tue	8.30AM	Nevada						
Arambula-Greenfield, Teresa	Sun	8.30AM	Calfn						
Ash, Doris	Sun	10.30AM	Oregon						
Atwater, Mary	Sun	8.30AM	Crystal	Tue	8.30AM	Emerald			
Atwood, Ronald	Sun	7.00PM	Explrm						
Audet, Richard	Mon	8.30AM	Suite 2625						
Ayala, Nancy	Tue	1.00PM	Calfn						
Backe, Kathrine	Sat	8.30PM	Emerald						
Bailey, Bambi	Sat	8.30PM	Emerald	Tue	8.30AM	GoldRhB			
Balling, John	Sun	8.30AM	Calfn						
Baker, Dale	Tue	8.30AM	GoldRhB						
Barba, Robertta	Mon	8.30AM	Monterey						
Barden, Laura	Sun	8.30PM	Emerald	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA
Barnea, Nitza	Sun	4.00PM	Redwood						
Barnes, Mary Ann	Sun	10.30AM	Redwood						
Barnes, Lehman	Sun	10.30AM	Redwood						
Barowy, William	Sun	8.30AM	Washtn	Tue	2.30PM	Emerald			
Barrera de Aragon, Maria	Sat	7.00PM	Suite 2601						
Barrow, Lloyd	Sat	8.30PM	Emerald	Tue	8.30AM	Monterey			
Barton, Angela	Sun	8.30AM	GoldRhB						
Bartley, Anthony	Tue	1.00PM	Washtn						
Baumert, Jürgen	Mon	2.30PM	Suite 2601						
Becker, Joe	Sun	10.30AM	GoldRhA						
Beeth, Michael	Mon	2.30PM	Oregon						
Bell, Beverley	Mon	10.30AM	Redwood						
Bell, Philip	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal	Mon	8.30AM	Portola
Bellamy, Mary	Sun	4.00PM	Calfn						
Belzer, Sharolyn	Sun	8.30AM	Emerald						
Ben-Chaim, David	Tue	8.30AM	Washtn						
Berg, Craig	Sun	8.30AM	Oregon	Sun	1.00PM	Nevada			
Berger, Carl	Sun	8.30AM	GoldRhA	Sun	10.30AM	Nevada	Sun	12.30PM	Crystal
	Sun	2.45PM	Crystal	Mon	10.30AM	GoldRhA	Tue	2.30PM	Portola
Berlin, Donna	Sun	1.00PM	Suite 2601	Mon	2.30PM	Portola			
Bernhardt, Elizabeth	Tue	8.30AM	Suite 2601						
Bianchini, Julie	Sun	1.00PM	Nevada						
Bitner, Betty	Sun	2.45PM	Suite 2601						
Black, Kathie	Sun	10.30AM	Monterey						
Black, Paul	Sun	1.00PM	Redwood						
Bleicher, Robert	Sat	8.30PM	Emerald						
Bloom, Jeff	Mon	8.30AM	Oregon						
Blumenfeld, Phyllis	Sun	4.00PM	GoldRhA						
Bodner, George	Tue	1.00PM	Redwood						
Bohren, Janet	Sun	8.30AM	GoldRhA						
Bolte, Claus	Mon	10.30AM	Nevada						
Bombaugh, Ruth	Tue	1.00PM	Emerald						
Bonnstetter, Ronald	Mon	2.30PM	GoldRhB	Mon	4.00PM	Washtn			

Boone, William	Sun	8.30AM	Suite 2625	Sun	1.00PM	Suite 2625			
Borun, Minda	Sun	2.45PM	GoldRhA						
Bos, Nathan	Sun	4.00PM	GoldRhA						
Boujaoude, Saouma	Sat	7.00PM	Suite 2625	Mon	8.30AM	Calfn			
Bowen, Craig	Sun	1.00PM	Calfn						
Breen, Timothy	Sun	4.00PM	Oregon						
Brickhouse, Nancy	Sun	8.30AM	Crystal						
Briscoe, Carol	Sun	10.30AM	Monterey						
Brody, Michael	Tue	8.30AM	Monterey						
Brown, David	Sun	8.30AM	Redwood	Mon	2.30PM	Oregon			
Brown, Fletcher	Mon	8.30AM	Suite 2601						
Brown, Sally	Sat	8.30PM	Emerald	Mon	2.30PM	Washtn			
Browne, Ron	Sun	7.00PM	Explrm						
Brunkhorst, Herbert	Sun	1.00PM	GoldRhB						
Bullock, Linda D.	Sun	8.30AM	Emerald						
Bunderson, Eileen D.	Sun	8.30AM	Suite 2601						
Burbules, Nick	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Burger, Nikki	Tue	8.30AM	Portola						
Burke, Christopher	Sat	7.00PM	Portola	Sun	8.30AM	Redwood			
Burry-Stock, Judith	Sun	10.30AM	Washtn						
Butler Kahle, Jane	Sun	4.00PM	GoldRhB	Mon	8.30AM	Emerald	Mon	10.30AM	GoldRhA
	Tue	10.30AM	Emerald	Tue	2.30PM	GoldRhB			
Butts, David P.	Sun	4.00PM	Calfn						
Bybee, Roger	Tue	1.00PM	Crystal						
Cabrera-Castro, Maria	Sat	7.00PM	Suite 2601						
Caggiano, Mary	Sat	8.30PM	Emerald	Mon	4.00PM	Portola			
Camacho, Moisés	Tue	1.00PM	Portola						
Campbell, James	Sun	1.00PM	Oregon						
Campbell-Williams, Mark	Mon	4.00PM	GoldRhA						
Carnes, Nathan	Sun	8.30AM	Emerald						
Cartledge, Frank	Sun	4.00PM	Nevada						
Caseau, Dana	Sun	1.00PM	Oregon						
Castaño, Norma C.	Sun	2.45PM	Suite 2625	Mon	10.30AM	Monterey			
Cavallo, Ann	Sun	4.00PM	Monterey						
Cavazos, Lynne	Sun	8.30AM	GoldRhB						
Champagne, Audrey	Sat	7.00PM	GoldRhA	Mon	10.30AM	Redwood	Tue	1.00PM	Crystal
Chandler, Frances	Sun	7.00PM	Explrm						
Chang, Ching-Kuch	Mon	10.30AM	Portola						
Charron, Elizabeth	Sun	1.00PM	GoldRhA						
Chevalier, Susan	Tue	2.30PM	Oregon						
Chin, Chi-Chin	Sun	7.00PM	Explrm						
Chiu, Mei-Hung	Sat	7.00PM	Portola						
Christensen, Clare	Sun	1.00PM	Calfn						
Chyuan, Jong-Pyng	Tue	2.30PM	Nevada						
Clark, Helen	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Clay, Samuel	Sun	10.30AM	Suite 2625						
Clement, John	Sun	2.45PM	GoldRhB						
Cobern, William	Sun	2.45PM	Oregon	Tue	8.30AM	Oregon	Tue	2.30PM	Crystal
Coble, Charles	Mon	2.30PM	GoldRhB						
Cogan, Leland	Sun	2.45PM	Suite 2601						
Coleman, Sharon	Sat	8.30PM	Emerald						
Collins, Angelo	Sat	7.00PM	Oregon	Tue	1.00PM	Crystal			
Colombo de Cudmani, Leonor	Sun	7.00PM	Explrm						
Cook, Julie	Sun	8.30AM	Emerald	Sun	4.00PM	Suite 2625			
Coppola, Brian	Sun	10.30AM	Nevada						
Cracolice, Mark	Sun	2.45PM	Oregon	Tue	8.30AM	Washtn			
Crawford, Barbara	Sun	8.30AM	Emerald						
Crawley, Frank	Sat	8.30PM	Emerald						
Cronin, Patrick	Sun	4.00PM	Portola						
Crow, Linda	Mon	2.30PM	GoldRhB						
Cuevas-Arteaga, Cecilia	Mon	4.00PM	Monterey						
Cunningham, Christine	Mon	8.30AM	Suite 2625	Tue	1.00PM	Suite 2601			
Czerniak, Charlene	Sun	2.45PM	Redwood						
Dai, Mei-Fun Wang	Mon	8.30AM	Monterey						
Damnjanovic, Arta	Tue	2.30PM	Monterey						
Dana, Tom	Sun	1.00PM	GoldRhA	Tue	8.30AM	Emerald			
Davidson, Kerry	Sun	4.00PM	Nevada						

Davis, Kathleen	Tue	2.30PM	GoldRhB						
Davis, Elizabeth	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal	Mon	8.30AM	Portola
Davis, Nancy	Sat	7.00PM	Oregon	Mon	4.00PM	GoldRhA			
de Castillo, Guadalupe	Sat	8.30PM	Emerald	Tue	1.00PM	Calfn			
de Isaacs, Lydia	Mon	10.30AM	Monterey						
de Jong, Onno	Sun	4.00PM	Emerald						
de Kidder, Francisca Garcia	Sun	1.00PM	Oregon						
de Samudio, Matilde	Mon	10.30AM	Monterey						
Delacôte, Goéry	Mon	2.30PM	GoldRhA						
Demastes, Sherry	Mon	10.30AM	Portola						
Denning, Rebecca	Sun	4.00PM	Portola						
Deru, David	Tue	2.30PM	Emerald						
Desouza, Shireen	Sun	7.00PM	Explrm						
Destino, Thomas	Tue	8.30AM	Suite 2601						
Dickinson, Valarie	Tue	8.30AM	Nevada						
Dickinson Bird, Mary	Mon	8.30AM	Suite 2601	Tue	2.30PM	Emerald			
Dierking, Lynn	Sun	10.30AM	Redwood	Sun	2.45PM	GoldRhA			
Dillon, Justin	Mon	10.30AM	GoldRhB						
Doherty, Cindy	Sat	7.00PM	Oregon						
Doolittle, Allen	Sat	7.00PM	GoldRhB						
Dooms, Patrick	Tue	1.00PM	Emerald						
Doran, Rodney	Sun	1.00PM	Redwood						
Dori, Yehudit	Mon	10.30AM	Califn						
Dorman, Jeffrey	Mon	4.00PM	Suite 2601						
Dorough, Donna	Sun	2.45PM	GoldRhB	Sun	7.00PM	Explrm			
Doster, Liz	Tue	1.00PM	Nevada						
Douma, Joost	Sun	7.00PM	Explrm						
Driver, Rosalind	Sun	4.00PM	Emerald						
Druger, Marvin	Tue	8.30AM	Emerald						
Duek, JodyLee	Tue	8.30AM	Washtn						
Duffy, Maryellen	Mon	8.30AM	Nevada						
Duit, Reinders	Sun	4.00PM	Emerald	Mon	2.30PM	Suite 2601			
Durham, Mary	Sun	8.30AM	Emerald						
Duschl, Richard	Sun	10.30AM	GoldRhA	Sun	4.00PM	Emerald	Mon	4.00PM	Redwood
Dykstra, Dewey	Sun	10.30AM	Portola						
Edgington, Judith	Mon	8.30AM	Calfn						
Edmondson, Katherine	Sun	10.30AM	Nevada						
Elliot, Tom	Sun	10.30AM	Calfn						
Ellis, James	Sun	7.00PM	Explrm						
Enochs, Larry	Sat	7.00PM	Redwood	Mon	10.30AM	GoldRhB			
Evans, Robert	Tue	1.00PM	Suite 2601	Tue	2.30PM	Suite 2601			
Eylon, Bat Sheva	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Fairbrother, Robert	Mon	10.30AM	GoldRhB						
Falk, John	Sun	2.45PM	GoldRhA						
Farragher, Pierce	Tue	8.30AM	Portola						
Feldman, Allan	Sun	10.30AM	Suite 2601						
Fetters, Marcia	Sun	1.00PM	Nevada						
Finkel, Liza	Sun	10.30AM	GoldRhB						
Finley, Fred	Sun	4.00PM	Crystal						
Finley, Sandra	Sun	8.30AM	Emerald						
Fisher, Darrell	Sun	8.30AM	Calfn						
Fisher, Robert	Mon	10.30AM	Suite 2625						
Fleener, M. Jayne	Sun	10.30AM	Suite 2601						
Flick, Lawrence	Sun	8.30AM	Emerald	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA
Foley, Brian	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal	Mon	8.30AM	Portola
Fortner, Rosanne	Sat	7.00PM	Washtn						
Fox, JoAnna	Sun	4.00PM	Calfn						
Fraser, Barry	Sat	4.00PM	Emerald	Sun	10.30AM	Emerald	Mon	8.30AM	GoldRhA
Freeman, John	Sun	10.30AM	Calfn						
Frederiksen, John	Sun	2.45PM	Portola						
French, Jenice	Sun	2.45PM	Calfn						
Friedler, Yael	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Friedman, Jeffrey	Sun	4.00PM	Portola						
Gabel, Dorothy	Sun	8.30AM	GoldRhA	Mon	10.30AM	GoldRhA			
Gallagher, James	Sat	7.00PM	Nevada	Sun	1.00PM	GoldRhB	Mon	4.00PM	Emerald
Gallard, Alejandro	Sat	7.00PM	Oregon	Mon	4.00PM	Monterey	Tue	8.30AM	Suite 2601
Garcia-Bravo, William	Mon	4.00PM	Monterey						

Gaskell, Jim	Sun	10.30AM	Crystal	Mon	2.30PM	Suite 2625			
Gattis, Kenneth	Sat	8.30PM	Emerald	Sun	10.30AM	Suite 2625			
Gee, Carrie	Mon	8.30AM	GoldRhA	Mon	10.30AM	Suite 2601			
Gerber, Brian	Sun	1.00PM	Suite 2625						
Germann, Paul	Sun	10.30AM	Suite 2625	Sun	4.00PM	Suite 2601			
Gess-Newsome, Julie	Sun	8.30AM	Nevada	Sun	1.00PM	GoldRhA			
Gibson, Adrienne	Mon	10.30AM	Portola						
Giddings, Geoffrey	Mon	4.00PM	Washtn						
Gilbert, John	Sun	10.30AM	Emerald	Sun	4.00PM	Emerald			
Gilmer, Penny	Mon	10.30AM	Suite 2601	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA
Ginns, Ian	Sat	8.30PM	Emerald						
Ginossar, Shlomit	Sun	8.30AM	Redwood						
Glick, Judith	Tue	1.00PM	Suite 2601						
Glynn, Shawn	Sun	10.30AM	Emerald						
Goldberg, Fred	Sun	10.30AM	Portola						
Gomez, Alfonso	Tue	1.00PM	Calfn						
Good, Ron	Sat	7.00PM	Crystal	Sun	8.30AM	Crystal	Tue	8.30AM	Crystal
Gore, Michael	Mon	8.00PM	Crystal						
Grewal, Joe	Tue	8.30AM	Portola						
Griffin, Janette	Sat	7.00PM	Suite 2625	Mon	8.30AM	Calfn			
Griffiths, Alan	Sun	2.45PM	Oregon						
Grimellini-Tomasini, Nella	Mon	10.30AM	Redwood						
Grimes, Katheryn	Tue	1.00PM	Emerald						
Grynkewich, Linda	Sun	2.45PM	Nevada						
Guo, Chorng-Jee	Sat	8.30PM	Emerald						
Gustafson, Brenda	Sun	4.00PM	Redwood						
Guy, Mark	Sun	4.00PM	Suite 2601						
Hack, Constance	Sat	8.30PM	Emerald						
Hackling, Mark	Mon	8.30AM	Nevada						
Hagelin, Linda	Sun	7.00PM	Explrm						
Hallenbeck, Mark	Mon	8.30AM	Oregon						
Halloun, Ibrahim	Mon	8.30AM	GoldRhA	Tue	8.30AM	Calfn			
Hameyer, Uwe	Sun	4.00PM	Oregon						
Hamid, Mohd	Tue	1.00PM	Nevada						
Hammond, Roselyn	Mon	2.30PM	Nevada						
Haney, Jodi	Sun	2.45PM	Redwood						
Harding, Jan	Mon	8.30AM	Emerald						
Harrison, Allan	Sun	10.30AM	Emerald	Tue	8.30AM	Oregon	Tue	1.00PM	Washtn
Harrison, Christine	Mon	10.30AM	GoldRhB						
Haury, David	Mon	4.00PM	Suite 2601						
Häussler, Peter	Mon	2.30PM	Suite 2601						
Hayes, Michael	Mon	2.30PM	Monterey						
Hazelwood, Constanza	Sat	8.30PM	Emerald	Sun	8.30AM	GoldRhB	Mon	4.00PM	Monterey
Hedgepeth, David	Sat	8.30PM	Emerald						
Helgeson, Stanley	Sun	1.00PM	Suite 2601	Mon	8.30AM	Monterey			
Helms, Jenifer	Tue	8.30AM	Calfn						
Henderson, David	Mon	10.30AM	Nevada						
Hennessy, Gertrude	Mon	10.30AM	Redwood						
Henning, Elizabeth	Sun	8.30AM	Oregon						
Henson, Stanley	Tue	1.00PM	Emerald						
Hepburn, Gary	Mon	10.30AM	Suite 2601	Mon	2.30PM	Suite 2625			
Hestenes, David	Mon	8.30AM	Oregon						
Hewson, Peter	Sun	4.00PM	Emerald	Mon	10.30AM	Redwood	Mon	2.30PM	Suite 2601
Hildebrand, Gaell	Sun	8.30AM	Suite 2601						
Hill, Greg	Sat	7.00PM	Nevada						
Hoadley, Christopher	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Hobden, Paul	Tue	8.30AM	Nevada						
Hoffman, Henrietta	Mon	8.30AM	GoldRhA						
Hoffmann, Lore	Mon	2.30PM	Suite 2601						
Hofstein, Avi	Mon	4.00PM	Washtn						
Holliday, William	Tue	2.30 PM	Redwood						
Holthuis, Nicole	Tue	8.30AM	Calfn						
Hsi, Sherry	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Hsiung, Chao-Ti	Mon	10.30AM	Washtn						
Hsiung, Tung-Hsing	Sun	8.30AM	Emerald						
Hsueh, Tuang-Huang	Sat	7.00PM	Washtn						
Huang, Iris	Sat	7.00PM	Portola						

Hudson, Terry	Sun	2.45PM	Suite 2601						
Hudson, Sharon	Sun	1.00PM	Monterey						
Huffman, Douglas	Sun	4.00PM	Suite 2625						
Hug, William	Sun	10.30AM	Monterey	Mon	4.00PM	Calfn			
Huinker, DeAnn	Sat	7.00PM	Redwood						
Hurd, Paul DeHart	Mon	4.00PM	Emerald						
Hurst, Roy	Sun	4.00PM	Suite 2625	Mon	8.30AM	GoldRhB			
Husén, Torsten	Sat	7.00PM	GoldRhA						
Hwang, Bao-tyan	Tue	8.30AM	Oregon						
Iuli, Richard	Sun	2.45PM	Monterey						
Iwasyk, Marletta	Sun	10.30AM	Oregon						
Jackson, David	Sun	1.00PM	Portola	Mon	4.00PM	Portola			
Jackson, Shari	Sun	10.30AM	GoldRhB						
Jacobs, Mary-Ellen	Sun	4.00PM	Nevada						
Jacobowitz, Roberta	Sat	7.00PM	Nevada						
James, Robert	Sun	1.00PM	GoldRhB						
Jarvis, Tina	Sun	7.00PM	Explrm	Mon	8.30AM	Emerald	Tue	8.30AM	Washtn
Jasalavich, Sheila	Sun	2.45PM	Suite 2601						
Jax, Dan	Sat	7.00PM	Washtn						
Jeffries, Carolyn	Sun	8.30AM	Emerald						
Jegede, Olugbemiro	Sun	2.45PM	Nevada	Mon	10.30AM	Nevada			
Jensen, Murray	Sun	2.45PM	Calfn	Mon	8.30AM	Suite 2601			
Johnson, Judith	Sun	1.00PM	Monterey						
Johnson, Sandra	Tue	2.30PM	Emerald						
Johnston, David	Sun	7.00PM	Explrm						
Johnston, Jane	Sat	7.00PM	Suite 2625						
Jones, Leslie	Tue	8.30AM	Monterey						
Jones, Gail	Sun	2.45PM	Washtn						
Jones, Loretta	Sun	8.30AM	GoldRhA	Sun	4.00PM	Washtn			
Jorde, Doris	Mon	8.30AM	Emerald	Tue	1.00PM	GoldRhB			
Joslin, Paul	Sun	8.30AM	Crystal						
Jungwirth, Ehud	Sun	8.30AM	Monterey						
Kali, Yael	Sat	8:30PM	Emerald						
Kamen, Michael	Mon	8.30AM	Oregon	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA
Karunaratne, Sunethra	Tue	1.00PM	Emerald						
Kass, Heidi	Mon	2.30PM	Redwood	Tue	1.00PM	Portola			
Kattmann, Ulrich	Mon	2.30PM	Oregon						
Kean, Elizabeth	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA			
Keeves, John	Sat	7.00PM	GoldRhA	Sun	10.30AM	Emerald	Tue	1.00PM	GoldRhB
Keiffer-Barone, Susan	Sat	7.00PM	Portola	Mon	10.30AM	Oregon			
Keiny, Shoshana	Mon	10.30AM	Calfn						
Keller, Jill	Sun	10.30AM	Calfn	Sun	1.00PM	Redwood			
Kelly, Christine	Tue	2.30 PM	Redwood						
Kelly, Gregory	Mon	8.30AM	Nevada	Tue	8.30AM	Calfn			
Kermis, William	Mon	10.30AM	Portola	Tue	2.30PM	Emerald			
Kerr, Patricia	Sun	10.30AM	Nevada						
Kesner, Miri	Mon	8.30AM	GoldhB						
Keys, Carolyn	Mon	8.30AM	Suite 2625						
Kirkpatrick, Doug	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Klapper, Michael	Mon	8.30AM	Redwood	Mon	4.00PM	Suite 2625			
Knight, Stephanie	Tue	8.30AM	GoldRhA						
Koballa, Thomas	Sun	4.00PM	Calfn	Mon	8.30AM	Emerald			
Kokoski, Teresa	Tue	2.30PM	Calfn						
Komorek, Michael	Sun	7.00PM	Explrm						
Koran, John	Sun	10.30AM	Redwood	Mon	8.30AM	Portola	Tue	2.30 PM	Redwood
Koran, Mary Lou	Sun	10.30AM	Redwood						
Korthagen, Fred	Sun	4.00PM	Emerald						
Krajcik, Joseph	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal	Sun	4.00PM	GoldRhA
	Mon	8.30AM	Portola						
Krockover, Gerald	Sun	1.00PM	GoldRhB						
Kuiper, Wilmad	Tue	8.30AM	Redwood						
Kulm, Gerald	Tue	8.30AM	GoldRhA						
Kumar, David	Sun	1.00PM	Suite 2601						
Kurose, Akiko	Sun	10.30AM	Oregon						
Kurth, Lori	Sun	8.30AM	GoldRhB	Sun	10.30AM	GoldRhA			
Kyhl, Caroline	Sat	8.30PM	Emerald						
Kyle, William	Mon	8.30AM	Crystal	Mon	4.00PM	Redwood			

Ladewski, Barbara	Sun	4.00PM	GoldRhA						
Larson, Jane	Sun	1.00PM	Suite 2625						
Lavoie, Derrick	Sun	8.30AM	Portola	Sun	1.00PM	Portola	Sun	4.00PM	Portola
Lawrence, Chris	Tue	2.30PM	Emerald						
Lawson, Anton	Sun	1.00PM	Suite 2625	Mon	10.30AM	GoldRhA			
Layman, John	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Lederman, Norman	Sun	8.30AM	Crystal	Sun	4.00PM	GoldRhA	Tue	8.30AM	Calfn
Lee, Kwan-Min	Mon	10.30AM	Oregon						
Lehman, James	Mon	4.00PM	Portola						
Lemke, Jay	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA			
Lennon, Alan	Sun	8.30AM	Emerald						
Lesh, Richard	Tue	8.30AM	GoldRhA						
Lewis, Eileen	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal	Mon	8.30AM	Portola
Lim, Siew-Bee	Mon	10.30AM	GoldRhB						
Lin, Huann-Shyang	Sat	8.30PM	Emerald						
Lin, Sheau-Wen	Sun	8.30AM	Nevada						
Lindauer, Ivo	Mon	8.30AM	Redwood	Tue	1.00PM	Nevada			
Linn, Marcia	Sun	8.30AM	GoldRhA	Sun	10.30AM	Portola	Sun	12.30PM	Crystal
	Sun	2.45PM	Crystal	Mon	8.30AM	Portola			
Liu, Chin-Tang	Tue	8.30AM	Redwood						
Loats, James	Sun	4.00PM	Washtn						
Lomask, Michael	Sun	1.00PM	Redwood						
Lord, Thomas	Tue	1.00PM	Suite 2601						
Lorsbach, Tony	Sun	4.00PM	Suite 2601						
Louden, William	Mon	2.30PM	Nevada						
Loving, Cathleen	Sun	8.30AM	Crystal	Sun	10.30AM	Suite 2601	Sun	4.00PM	Crystal
Lovitts, Barbara	Mon	8.30AM	Washtn						
Lowery Bretz, Stacey	Tue	1.00PM	Portola						
Lowrey, Kirsten	Tue	1.00PM	Redwood						
Luallen, Janet	Sat	7.00PM	Nevada						
Lubezky, Aviva	Mon	10.30AM	Calfn						
Lucas, Keith	Mon	10.30AM	Washtn	Tue	8.30AM	Nevada			
Lumpe, Andrew	Sun	2.45PM	Redwood						
Lunetta, Vincent	Sun	10.30AM	GoldRhB	Tue	8.30AM	Emerald			
Lynch, Sharon J.	Sat	7.00PM	Calfn	Sun	2.45PM	Washtn			
MacIsaac, Dan	Tue	1.00PM	Redwood						
MacKinnon, Allan	Sun	8.30AM	Washtn						
Madhok, Jacquie	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Magnusson, Shirley	Sun	4.00PM	Portola						
Maley, Mark	Sat	7.00PM	Washtn						
Maor, Dorit	Mon	8.30AM	GoldRhA	Tue	2.30PM	Portola			
Marble, Stephen	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA			
Marek, Edmund	Sun	2.45PM	Washtn						
Marencik, Joseph	Mon	4.00PM	Nevada						
Mariani, Maria	Sun	8.30AM	Redwood						
Marion, Scott	Sun	4.00PM	Oregon						
Marlow, Michael	Mon	4.00PM	Suite 2601						
Marlow, Stacey	Sat	7.00PM	Monterey						
Marshall-Bradley, Tina	Sun	1.00PM	GoldRhB						
Martin, Megan	Sat	7.00PM	GoldRhB						
Martinello, Marian	Sun	10.30AM	Monterey						
Martinez, Michael	Mon	2.30PM	Portola						
Marx, Ronald	Sun	4.00PM	GoldRhA						
Mason, Diana	Sun	4.00PM	Suite 2625	Mon	4.00PM	Nevada			
Mastrilli, Thomas	Sat	8.30PM	Emerald						
Matson, John	Sun	1.00PM	Monterey	Tue	8.30AM	Monterey			
Matthews, Michael	Sun	4.00PM	Crystal	Tue	8.30AM	Crystal			
Mattson, Sue	Sun	7.00PM	Explrm						
Mayer, Victor	Sat	7.00PM	Washtn						
Mayer, Jürgen	Sun	8.30AM	Suite 2625						
Mayer-Smith, Jolie	Tue	1.00PM	Emerald						
McClafferty, Terence	Sun	7.00PM	Explrm						
McConney, Andrew	Tue	2.30PM	Suite 2601						
McDaniel, Patrice	Sun	8.30PM	Emerald						
McElroy, Keith	Sun	7.00PM	Explrm						
McGinn, Michelle	Sat	8.30PM	Emerald						
McGinnis, Randy	Sun	4.00PM	Redwood	Mon	2.30PM	Calfn	Tue	2.30 PM	Redwood

McGlamery, Sheryl	Sun	1.00PM	GoldRhB	Mon	4.00PM	Calfn			
McMahon, Maureen	Mon	4.00PM	Portola	Tue	2.30 PM	Redwood			
McRobbie, Campbell	Mon	8.30AM	GoldRhB						
Mdletshe, Khumbulani	Tue	2.30PM	Emerald						
Melear, Claudia	Sun	8.30AM	Suite 2601						
Minstrell, Jim	Sun	10.30AM	Portola	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal
Moje, Elizabeth	Mon	8.30AM	Crystal						
Molina, Fernando	Sun	1.00PM	Washtn	Mon	4.00PM	Monterey			
Moon, Barbara	Sun	4.00PM	Redwood	Tue	2.30PM	Monterey			
Moore, John	Tue	2.30PM	Crystal						
Moore, Richard	Mon	8.30AM	Calfn						
Moore, Jacquelyn	Sun	4.00PM	Redwood						
Morais, Ana	Mon	2.30PM	Monterey						
Moreira, Marco	Mon	10.30AM	Monterey	Tue	1.00PM	Emerald			
Morrell, Patricia	Tue	2.30PM	Monterey						
Moscovici, Hedy	Mon	2.30PM	Washtn						
Muilenberg, Lawrence	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Mulholland, Judith	Mon	10.30AM	Washtn						
Murfin, Brian	Sun	8.30AM	Washtn						
Nachmias, Rafi	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Naidoo, Sharadh	Tue	8.30AM	Oregon						
Nakhleh, Mary	Mon	8.30AM	Monterey	Tue	1.00PM	Redwood			
Navarro, Estela	Sat	8.30PM	Emerald	Tue	1.00PM	Calfn			
Nelson, Barbara	Sun	4.00PM	Washtn						
Nesbit, Catherine	Sun	2.45PM	Calfn						
Niaz, Mansoor	Sat	7.00PM	Portola	Tue	8.30AM	Crystal			
Nichols, Sharon	Sun	8.30AM	Nevada	Mon	4.00PM	Suite 2625			
Nicolaos, Valanides	Tue	1.00PM	Portola						
Nieswandt, Martina	Mon	8.30AM	Suite 2625	Mon	2.30PM	Redwood			
Norman, Obed	Sun	8.30AM	Nevada	Sun	4.00PM	Suite 2601			
Norman, Katherine	Sun	2.45PM	Oregon	Mon	10.30AM	Oregon	Tue	1.00PM	Emerald
Norris, Stephen	Tue	2.30PM	Emerald						
Novak, Joseph	Sun	10.30AM	Nevada	Sun	2.45PM	Monterey			
O'Non, James	Sun	8.30AM	Suite 2625						
O'Raffert[illegible] Maureen	Mon	4.00PM	Nevada	Tue	2.30PM	Washtn			
O'Sullivan Kathleen	Sat	7.00PM	Oregon	Sat	8.30PM	Emerald			
Obitts, Stanley	Tue	2.30PM	Crystal						
Odom, Louis	Sun	4.00PM	Monterey	Mon	10.30AM	Washtn			
Odubunmi, Emmanuel	Tue	1.00PM	Emerald						
Ogbu, John	Sun	2.45PM	Emerald						
Oka, Evelyn	Mon	2.30PM	Redwood						
Okebukola, Peter	Sun	4.00PM	Suite 2625						
Olsen, Timothy	Sun	7.00PM	Explrm	Tue	2.30PM	Portola			
Olstad, Roger	Mon	8.30AM	Washtn						
Oren, Elaine	Sun	8.30AM	GoldRhB						
Orion, Nir	Tue	2.30PM	Monterey						
Orpwood, Graham	Sun	8.30AM	Suite 2625	Mon	2.30PM	Monterey			
Orquiza de Carvalho, Lizete	Sun	7.00PM	Explrm						
Ostrander, Ray	Tue	2.30PM	Oregon						
Ottevanger, Wout	Tue	8.30AM	Redwood						
Pacca, Jesuina	Sun	2.45PM	Suite 2625	Mon	10.30AM	Monterey			
Pachón, Ernesto	Sun	2.45PM	Suite 2625						
Palmeri, Amy	Sun	2.45PM	Redwood	Mon	10.30AM	Suite 2601			
Pankiewicz, Philip	Sun	2.45PM	Washtn						
Pankratius, William	Sun	1.00PM	Calfn	Tue	1.00PM	Washtn			
Pardo, Luz	Sun	2.45PM	Suite 2625						
Park, Sung Hye	Sun	8.30AM	Emerald						
Parke, Helen	Sun	4.00PM	Oregon	Tue	8.30AM	Redwood			
Parker, Dawn	Tue	8.30AM	GoldRhA						
Parker, Joyce	Sat	7.00PM	Nevada						
Parker, Lesley	Sun	8.30AM	Suite 2601	Sun	10.30AM	Emerald	Sun	4.00PM	GoldRhB
	Mon	8.30AM	Emerald						
Parsons, Sharon	Sun	8.30AM	Emerald						
Pea, Roy	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Peas[illegible], Kathleen	Mon	10.30AM	Nevada						
Pedersen, Jon	Sun	2.45PM	GoldRhA						
Peiffer, Bernadette	Sun	8.30AM	Calfn						

Penick, John	Mon	10.30AM	Suite 2625	Mon	2.30PM	GoldRhB			
Pesa, Marta	Sun	1.00PM	Washtn	Sun	7.00PM	Explrm			
Peters, Joe	Sun	8.30AM	Portola						
Petrosino, Anthony	Sun	7.00PM	Explrm						
Phillips, Linda	Mon	8.30AM	Suite 2625	Mon	10.30AM	Nevada			
Phillips, Denis	Sat	4.00PM	Emerald	Sun	8.30AM	Crystal	Sun	4.00PM	Crystal
	Tue	2.30PM	Crystal						
Pilatowski, Ronald	Sat	7.00PM	Washtn						
Pirkle, Sheila	Sat	7.00PM	Monterey	Sun	4.00PM	Nevada			
Plucker, Jonathan	Sun	10.30AM	Calfn						
Pollard, Rebecca	Mon	2.30PM	Monterey						
Pontius, Richard	Sat	7.00PM	Washtn						
Powell, Richard	Sun	1.00PM	GoldRhA						
Pyle, Eric J.	Sat	7.00PM	Suite 2625						
Kusen, Senta	Sun	10.30AM	Washtn						
Ralston, Susan	Sun	8.30AM	Nevada						
Reap, Melanie	Sun	7.00PM	Explrm						
Reinhold, Peter	Mon	8.30AM	Nevada						
Rennie, Léonie	Sun	1.00PM	Suite 2625	Sun	4.00PM	GoldRhB	Mon	8.30AM	Emerald
	Mon	2.30PM	GoldRhA	Tue	8.30AM	Emerald			
Reyes-Garcia, Carlos	Sat	7.00PM	Suite 2601	Sun	8.30AM	Emerald	Sun	1.00PM	Washtn
Reyes-Herrera, Lilia	Sun	1.00PM	Washtn	Sun	7.00PM	Explrm			
Rice, Diana	Tue	1.00PM	Washtn						
Richardson, Lon	Sat	1.00PM	GoldRhB	Mon	4.00PM	Oregon	Tue	1.00PM	Emerald
	Tue	2.30PM	Suite 2601						
Richmond, Gail	Sun	8.30AM	GoldRhB	Sun	1.00PM	Nevada	Mon	2.30PM	Oregon
Rickey, Dawn	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Riggs, Iris	Sat	7.00PM	Redwood						
Riley, Dana	Sun	4.00PM	GoldRhB	Sun	7.00PM	Explrm			
Riley, Joseph	Sun	4.00PM	Calfn	Tue	1.00PM	Nevada			
Rillero, Peter	Tue	1.00PM	Emerald	Tue	2.30PM	Washtn			
Ritchie, Stephen	Tue	8.30AM	Nevada	Tue	2.30PM	Washtn			
Robeck, Ed	Sun	1.00PM	Oregon	Mon	2.30PM	Suite 2625			
Robinson, Scott	Sun	8.30AM	Emerald						
Rodriguez, Alberto	Mon	2.30PM	Calfn						
Rodriguez-Munoz, Marisol	Tue	8.30AM	Suite 2601						
Roeber, Edward	Sat	7.00PM	GoldRhB	Mon	2.30PM	Suite 2625			
Rogers, Laura	Mon	2.30PM	Nevada						
Romance, Nancy	Sun	1.00PM	Suite 2601						
Ron, Salit	Sun	8.30AM	Emerald						
Rop, Charles	Sun	2.45PM	Nevada	Mon	8.30AM	GoldRhB			
Roth, Wolff-Michael	Sun	10.30AM	GoldRhA	Mon	10.30AM	Suite 2601	Tue	8.30AM	Crystal
	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA			
Roth, Kathleen	Sun	8.30AM	GoldRhB	Sun	10.30AM	GoldRhA			
Rowell, Patricia	Sun	4.00PM	Redwood						
Roychoudhury, Anita	Sun	1.00PM	GoldRhA	Mon	10.30AM	Washtn			
Rubba, Peter	Sun	4.00PM	Monterey						
Ruiz-Primo, Maria	Sun	1.00PM	Redwood						
Rutherford, James	Sat	7.00PM	Calfn						
Ryder, Exyie	Sun	4.00PM	Nevada						
Rye, James	Sun	10.30AM	Calfn						
Ryu, Tae	Sun	10.30AM	Crystal						
Sachse, Thomas	Mon	2.30PM	GoldRhB						
Said, Safian	Sun	1.00PM	Monterey						
Salmi, Hannu	Sat	7.00PM	Suite 2625						
Sanders, Jo	Tue	2.30PM	Oregon						
Scantlebury, Kate	Mon	8.30AM	Emerald	Tue	8.30AM	GoldRhB			
Scharmann, Lawrence	Sat	7.00PM	Redwood	Mon	2.30PM	Washtn	Mon	4.00PM	Redwood
Schauble, Leona	Sun	10.30AM	GoldRhA						
Schmidt, Hans-Jurgen	Sun	8.30AM	Redwood						
Schmidt, William H.									
Schoneweg, Cristine	Sun	8.30AM	Emerald						
Schriver, Marti	Tue	2.30PM	Emerald						
Scott, Terry	Mon	8.30AM	Crystal						
Segal, Gilda	Sun	8.30AM	Oregon	Mon	2.30PM	Suite 2625			
Settlage, John	Sun	10.30AM	Calfn						
Shapiro, Bonnie	Tue	1.00PM	GoldRhA	Tue	2.30PM	GoldRhA			

Sharp, Lynn	Tue	2.30PM	Nevada						
Shaw, Jerome	Sun	8.30AM	Suite 2601	Sun	1.00PM	Oregon			
She, Hsiao-Ching	Mon	8.30AM	Calfn	Mon	10.30AM	Oregon			
Shepardson, Daniel	Tue	2.30PM	Nevada						
Sheppard, Judith	Sun	8.30AM	Emerald						
Sherman, Twyla G.	Mon	2.30PM	Portola						
Sherwood, Robert	Sun	8.30AM	GoldRhA	Tue	2.30PM	Portola			
Shokere, Luke	Mon	8.30AM	Redwood	Tue	8.30AM	Monterey			
Shroyer, Gail	Sun	10.30AM	Washtn	Mon	10.30AM	GoldRhB			
Shymansky, James	Sat	8.30PM	Emerald	Sun	1.00PM	Suite 2601			
Simmons, Patricia	Sat	1.00PM	GoldRhB	Sun	1.00PM	GoldRhB	Mon	4.00PM	Oregon
Simpson, Dorothy	Sun	10.30AM	Oregon						
Slater, Timothy	Sun	10.30AM	Suite 2625						
Smith, Deborah	Sun	8.30AM	GoldRhB						
Smith, Mike	Tue	2.30PM	Crystal						
Smith, Edward	Tue	2.30PM	Calfn						
Smith, R. Timothy	Sun	10.30AM	Suite 2625						
Sode, John	Sun	8.30AM	Washtn	Mon	8.30AM	Suite 2601			
Soloway, Elliot	Sun	10.30AM	GoldRhB	Sun	4.00PM	GoldRhA			
Songer, Nancy	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal	Sun	4.00PM	GoldRhA
Spector, Barbara	Sun	1.00PM	GoldRhB						
Spiegel, Sam	Sat	7.00PM	Oregon						
Spiller, Richard	Sun	8.30AM	Emerald						
Spitulnik, Michele	Sun	1.00PM	Portola						
Spitulnik, Jeff	Sun	10.30AM	GoldRhB						
Stanley, William	Sun	8.30AM	Crystal						
Stark, Rae	Tue	2.30PM	Calfn						
Stein, Fred	Sun	4.00PM	Washtn						
Stern, Judy	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Stocklmayer, Sue	Sun	10.30AM	Emerald	Mon	8.00PM	Crystal	Tue	2.30PM	Calfn
Stockman, Stephanie	Tue	2.30 PM	Redwood						
Stoddart, Trish	Tue	8.30AM	Suite 2601						
Stratford, Steve	Sun	10.30AM	GoldRhB						
Streveler, Ruth	Tue	1.00PM	Emerald						
Stubbs, Harriett	Mon	4.00PM	Suite 2625						
Stuessy, Carol	Tue	8.30AM	GoldRhA						
Suarez-Gómez, Alfonso	Sun	12.30PM	Washtn						
Sullivan, Sherry	Sun	1.00PM	Calfn						
Sunal, Dennis	Sun	7.00PM	Explrm						
Sunbury, Susan	Sun	7.00PM	Explrm						
Suzuki, Mariko	Tue	8.30AM	Oregon						
Svec, Michael	Sun	1.00PM	Portola						
Sykes, Gary	Sat	9.30AM	GoldRhA						
Talsma, Valerie	Mon	8.30AM	GoldRhB						
Tamir, Pinchas	Sun	1.00PM	Redwood						
Taylor, Marilyn	Sun	4.00PM	Washtn						
Taylor, Peter	Mon	2.30PM	Redwood	Mon	4.00PM	GoldRhA			
Thiele, Rodney	Sun	10.30AM	Emerald	Sun	2.45PM	GoldRhB			
Thomas, Julie	Sun	8.30AM	Emerald						
Thomas, Jeff	Sun	7.00PM	Explrm						
Thomas, Ray									
Thoresen, Carol	Sun	8.30AM	Nevada						
Tims, Joanne	Sun	4.00PM	GoldRhB						
Tinker, Bob	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Tippins, Deborah	Sun	8.30AM	GoldRhB	Mon	8.30AM	Redwood	Tue	8.30AM	Emerald
	Tue	1.00PM	Oregon						
Tobin, Kenneth	Sun	1.00PM	GoldRhA	Sun	2.45PM	Emerald	Mon	8.30AM	GoldRhA
	Tue	8.30AM	Crystal						
Tomanek, Debra	Sun	8.30AM	Monterey	Tue	1.00PM	Emerald			
Tomkiewicz, Warren	Tue	8.30AM	Monterey						
Toolin, Regina	Mon	2.30PM	Calfn						
Treagust, David	Sat.	7.00PM	Nevada	Sun	10.30AM	Emerald	Sun	1.00PM	Emerald
	Mon	8.30AM	GoldRhA						
Trowbridge, John	Sun	8.30AM	Monterey						
Trumbull, Deborah	Sun	8.30AM	GoldRhB	Mon	2.30PM	Calfn			
Tuan, Hsiao-Lin	Tue	2.30PM	Emerald						
Tucker, Gary	Tue	8.30AM	GoldRhA						

Tuss, Paul	Sat	8.30PM	Emerald	Mon	4.00PM	Calfn			
Twiest, Mark	Sun	1.00PM	GoldRhB						
Uyeda, Steven	Mon	4.00PM	Calfn						
Valero, Michel	Sat	7.00PM	Suite 2601						
van Zee, Emily	Sun	10.30AM	Oregon						
Varelas, Maria	Sun	10.30AM	GoldRhA						
Varrella, Garry	Sun	10.30AM	Washtn						
Venville, Grady	Sun	10.30AM	Emerald						
Viggiano, Elizabeth	Sat	7.00PM	Oregon						
Vitale, Michael	Sun	8.30AM	Oregon	Sun	1.00PM	Suite 2601			
Volkmann, Mark	Mon	8.30AM	Crystal						
Vopava, Judy	Sun	10.30AM	Washtn						
Wade, Philip	Tue	8.30AM	Washtn	Tue	2.30PM	GoldRhB			
Walberg, Herbert	Sat	7.00PM	GoldRhA	Sun	10.30AM	Emerald			
Waldrip, Bruce	Mon	2.30PM	Nevada	Tue	2.30PM	Washtn			
Wallace, John	Sat	7.00PM	Monterey	Sun	4.00PM	Suite2601	Mon	8.30AM	GoldRhA
Wandersee, James	Sun	10.30AM	Oregon	Sun	4.00PM	Nevada	Mon	8.30AM	GoldRhA
Watson, Scott	Sat	8.30PM	Emerald						
Watters, James	Sat	7.00PM	Redwood						
Wavering, Michael	Sun	2.45PM	Monterey						
Weinland, Rick	Sun	12.30PM	Crystal	Sun	2.45PM	Crystal			
Weiss, Iris	Tue	10.30AM	Emerald						
Welicker, Miriam	Sun	8.30AM	Emerald						
Weller, Herman	Tue	1.00PM	Emerald						
Wesso, Iona	Sat	8.30PM	Emerald						
Westbrook, Susan	Mon	10.30AM	Suite 2625	Mon	4.00PM	Nevada	Tue	2.30PM	Nevada
White, Arthur	Sun	1.00PM	Suite 2601	Mon	2.30PM	Portola	Tue	1.00PM	Oregon
White, Barbara	Sun	2.45PM	Portola						
White, Loren	Mon	4.00PM	GoldRhA						
White, Robyn	Tue	2.30PM	Emerald						
Whitworth, Joan	Tue	2.30PM	GoldRhB						
Wiggins, John	Mon	8.30AM	Suite 2601						
Wild, Judy	Sun	10.30AM	Oregon						
Wilder, Melinda	Sat	7.00PM	Washtn						
Wildy, Helen	Mon	2.30PM	Washtn						
Willhite, K.T.	Sun	8.30AM	Emerald						
Williams, Mark	Sun	8.30AM	Portola						
Williams, Richard	Tue	8.30AM	Portola						
Williamson, Vickie	Sun	2.45PM	Nevada	Mon	10.30AM	Suite 2625			
Wiltz, Nancy	Tue	2.30 PM	Redwood						
Wong, E. David	Sun	2.45PM	GoldRhB	Mon	2.30PM	Redwood			
Wood, David	Tue	8.30AM	Redwood						
Woodin, Terry	Tue	1.00PM	Oregon						
Woods, Corey	Sat	8.30PM	Emerald						
Woods, John	Sun	8.30AM	Emerald						
Woolnough, Brian	Sun	10.30AM	Crystal						
Wubbels, Theo	Sun	10.30AM	Monterey	Sun	4.00PM	Emerald	Tue	1.00PM	GoldRhB
Wright, Emmett	Mon	10.30AM	Suite 2625						
Wynne, Cynthia	Sun	4.00PM	Monterey						
Yager, Robert	Sun	10.30AM	Washtn	Sun	1.00PM	GoldRhB	Mon	2.30PM	GoldRhB
	Mon	4.00PM	Washtn						
Yeany, Russell	Sat	7.00PM	Redwood	Tue	8.30AM	Crystal			
Yeroslavski, O.	Sun	8.30AM	Monterey						
Yore, Larry	Sun	8.30AM	Oregon						
Young, Deidra	Sun	10.30AM	Crystal						
Yu, Shu-Mey	Mon	8.30AM	Monterey						
Zadnik, Mario	Sun	1.00PM	Portola						
Zandvliet, David	Sun	8.30AM	Emerald						
Zeidler, Dana	Sun	10.30AM	Suite 2601						
Zietsman, Aletta	Sun	1.00PM	Monterey	Mon	10.30AM	Redwood			
Zohar, Anat	Tue	1.00PM	Emerald						
Zoller, Uri	Sun	10.30AM	Suite 2601	Mon	10.30AM	Calfn			
Zuckerman, June	Sun	4.00PM	Monterey						
Zuzovsky, Ruth	Sun	1.00PM	Nevada						